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North Carolina State Record

North Carolina State University



Undergraduate Catalog 1970-72

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New D. H. Hill Library addition. (*Photo by Bill Threewitts*)

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Undergraduate Catalog 1970-72

North Carolina State University • Raleigh



THE UNIVERSITY OF NORTH CAROLINA

(Six Component Institutions)

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By the act of the General Assembly of 1931 the University of North Carolina at Chapel Hill, the North Carolina College for Women at Greensboro (renamed the Woman's College of the University of North Carolina), and the North Carolina State College of Agriculture and Engineering at Raleigh were merged into The University of North Carolina.

By the act of the General Assembly of 1963 effective July 1, 1963, The University of North Carolina comprised: The University of North Carolina at Chapel Hill, The University of North Carolina at Greensboro and North Carolina State of The University of North Carolina at Raleigh.

By the act of the General Assembly of 1965 effective July 1, 1965, The University of North Carolina comprised: The University of North Carolina at Chapel Hill, The University of North Carolina at Charlotte, The University of North Carolina at Greensboro, and North Carolina State University at Raleigh.

By the act of the General Assembly of 1969 effective July 1, 1969, The University of North Carolina comprises: The University of North Carolina at Asheville, The University of North Carolina at Chapel Hill, The University of North Carolina at Charlotte, The University of North Carolina at Greensboro, The University of North Carolina at Wilmington and North Carolina State University at Raleigh.

Each institution has its own faculty and student body, and each is headed by a chancellor as its chief administrative officer. Unified general policy and appropriate allocation of function are effected by a single Board of Trustees and by the President with other administrative officers of The University. The general administration offices are located in Chapel Hill.

Members of the Board of Trustees are elected by the Legislature, and the Governor of North Carolina is chairman ex officio. A current list of members of the Board of Trustees is found on pages 464-466.

The chancellors of the component institutions are responsible to the President as the principal executive officer of The University of North Carolina.

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Chancellor John T. Caldwell

As a land-grant state university, North Carolina State University is involved in many ways in serving all the people of North Carolina and the nation through a wide array of instruction, research and extension programs. It serves hundreds of thousands annually in extension services, enrolls more than 13,000 students each semester in degree programs, and conducts scientific research on about 700 projects annually on the campus and at branch stations and laboratories. There are eight undergraduate schools, more than 70 degree programs, the graduate school and numerous special centers, institutes and interdisciplinary education, research and extension programs. The faculty, students and the public share a common pride in the University's accomplishments and a dedication to improve and expand them for the benefit of mankind.

ADMINISTRATION AND OFFICES

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LeRoy B. Martin, *Director*

OCCUPATIONAL EDUCATION CENTER

John K. Coster, *Director*

WUNC-TV

Jack Porter, *Director*

WATER RESOURCES INSTITUTE

David H. Howells, *Director*



THE UNIVERSITY

North Carolina State University was founded in 1887 as a land-grant institution in a higher education movement then sweeping the nation. These institutions were created through the federal Morrill Act of 1862 to expand the opportunity for higher education, primarily in the areas of "agriculture and the mechanic arts." Today, these institutions of higher learning now constitute the major public universities of the nation, pursuing all fields of knowledge and carrying out programs in every area of the world.

OPENED IN 1889

N. C. State University began operations as the North Carolina College of Agriculture and Mechanic Arts in 1889 with 45 students. Today, enrollment exceeds 13,000 men and women, with over 2,000 engaged in graduate study.

The present name, North Carolina State University, adopted in 1965, gives further stature to the institution in its expanding role as a major university.

WIDE RANGE OF PROGRAMS

N. C. State is comprised of eight principal academic divisions: the Schools of Agriculture and Life Sciences, Design, Education, Engineering, Forest Resources, Liberal Arts, Physical and Mathematical Sciences, and Textiles. They offer approximately 100 fields of study.

Since its founding, the institution's research, extension and academic programs have expanded rapidly, now requiring the services of more than 1,000 professional staff members, eight undergraduate schools, the graduate school, 17 branch agricultural experiment stations, and extension agents for each of the State's 100 counties. The total annual budget approximates \$60 million.

N. C. State University is accredited by the Southern Association of Colleges and Schools and the N. C. College Conference. Additionally, individual schools and departments are accredited by various associations in their respective fields. N. C. State holds memberships in the National Association of State Universities and Land-Grant Colleges, the American Council on Education, the College Entrance Examination Board, the National Commission on Accrediting, the Oak Ridge Institute of Nuclear Studies, and the Southern Association of Colleges and Schools.

SERVES ENTIRE STATE

N. C. State is a complex institution, effectively extending its burgeoning teaching, research and extension programs to all corners of the State, nation and to foreign lands. Augmenting its more formal academic

programs on its campus is University Extension which annually sponsors more than 100 short courses, workshops and conferences; correspondence courses; urban affairs programs and similar programs.

Among the University's first off-campus services was the Agricultural Extension Service, which today has offices in all of N. C.'s 100 counties and is responsible for the administration of one of the nation's largest 4-H programs.

Seventeen agricultural experiment stations also come under jurisdiction of the University, and serving the industrial economy of the State is a program similar to the one in agriculture, the Industrial Extension Service.

Current programs for fisheries research and in tree improvement, the world's largest, are indicative of N. C. State's diverse role in the advancement of scientific work on behalf of the State and nation. On the international level, N. C. State is carrying out three separate programs of education and research. These programs involve the efforts of staff members in international cooperation. The University has a cosmopolitan flavor with a sizeable international student enrollment representing 60 countries.

THE CAMPUS

The main University campus is located in Raleigh.

The central campus encompasses 2,500 acres and is valued at more than \$100 million. The physical plant includes 80 major classroom, laboratory and auxiliary facilities and buildings. Construction of new facilities—buildings, laboratories and classrooms—is constantly in progress.

Adjoining the central campus are several of its experimental farms and woodlands and its excellent football stadium. In addition to holdings in the Raleigh area, extensive agricultural and other types of research facilities are scattered throughout the State.

UNDERGRADUATE DEGREES

Bachelor's degrees of: environmental design in architecture, environmental design in landscape architecture, and product design.

Bachelor of Science degrees in:

Agriculture and Life Sciences (Business)—agricultural economics, animal science, crop science, horticultural science, poultry science and soil science; *(Science)*—agricultural economics, animal science, biological and agricultural engineering, botany, conservation, crop science, food science, entomology, horticultural science, plant protection, medical technology, poultry science, rural sociology, soil science, wildlife biology and zoology, (also preveterinary); *(Technology)*—agronomy, animal science, biological and agricultural engineering, food science, horticultural science and poultry science; *(Biological Sciences)*—biological sciences.

Education—agricultural education, vocational industrial education, technical education, mathematics education, industrial arts education, and science education.

Engineering—aerospace, ceramic, chemical, civil, (construction option), electrical, industrial, mechanical, materials and nuclear engineering; engineering mechanics; engineering operations; and furniture manufacturing and management.

Forest Resources—forestry, conservation, pulp and paper science and technology, natural resource recreation management, recreation and park administration, wood science and technology.

Liberal Arts—economics, English, history, politics, and philosophy.

Physical and Mathematical Sciences—applied mathematics, chemistry, statistics, computer science, geology, and physics.

Textiles—textile chemistry and textile technology.

Bachelor of Arts degrees in:

Education—psychology.

Liberal Arts—economics, English, French, Spanish, history, politics, philosophy, sociology speech-communication.

Physical and Mathematical Sciences—geology.

Professional degrees (fifth year)—ceramic engineer, chemical engineer, civil engineer, electrical engineer, industrial engineer, mechanical engineer, materials engineer and nuclear engineer.

GRADUATE DEGREES

Master's degrees of: adult education, agricultural education, agricultural economics, agriculture, animal science, applied mathematics, architecture, biological and agricultural engineering, biomathematics, botany, civil engineering, crop science, economics, education, electrical engineering, engineering mechanics, entomology, statistics, food science, forestry, genetics, guidance and personnel services, horticultural science, industrial arts education, industrial engineering, landscape architecture, mathematics education, mechanical engineering, microbiology, nutrition, physiology, plant pathology, poultry science, product design, public affairs, sociology, science education, soil science, technology for international development, teaching in mathematics, textile technology, urban design, vocational industrial education, wood and paper science, and zoology.

Master of Arts programs in: economics, English, history, and politics.

Master of Science programs in: adult and community college education, agricultural education, agricultural economics, animal science, biochemistry, biological and agricultural engineering, biomathematics, botany, ceramic engineering, chemical engineering, chemistry, civil engineering, crop science, electrical engineering, engineering mechanics, entomology, food science, forestry, genetics, geology, guidance and personnel services, horticultural science, industrial arts education, industrial engineering, marine science, mathematics education, mechanical engineering, ma-



terials engineering, mathematics, microbiology, nuclear engineering, nutrition, operations research, physics, physiology, plant pathology, poultry science, psychology, rural sociology, science education, soil science, statistics, textile chemistry, textile technology, vocational industrial education, wood and paper science, and zoology.

Doctor of Philosophy programs in: animal science, biochemistry, biological and agricultural engineering, biomathematics, botany, chemical engineering, chemistry, civil engineering, crop science, economics, electrical engineering, engineering mechanics, entomology, fiber and polymer science, food science, forestry, genetics, industrial engineering, marine science, materials engineering, mathematics, mechanical engineering, microbiology, nuclear engineering, nutrition, operations research, physics, physiology, plant pathology, psychology, sociology, soil science, statistics, wood and paper science, and zoology.

Doctor of Education programs in: adult and community college education and occupational education.

Admissions

An applicant must be of good moral character and present evidence of satisfactory preparation for work in his intended curriculum to be admitted as an undergraduate to a regular session of North Carolina State University. Academic aptitude is the prime factor in determining the admissibility of students.

Students of all races are equally welcome in North Carolina State University. Persons of all racial backgrounds may apply for and accept admission, confident that the policy and regular practice of the University will protect them from unfair discrimination.

Every applicant must complete an application form which may be obtained from:

Director of Admissions
North Carolina State University
Box 5126
Peele Hall
Raleigh, North Carolina 27607

The completed form should be returned to the above address by May 1 for consideration for the fall semester and by December 1 for consideration for the spring semester. A nonrefundable \$10 application fee must accompany the completed application form.

FRESHMAN ADMISSION

The applicant normally should be a graduate of an accredited high school and have the recommendation of the principal or headmaster. Nongraduates should normally have a high school equivalency certificate, have the minimum high school mathematics preparation, and present other evidence of maturity and ability to deal effectively with college work.

Credentials necessary for making an admissions decision include: the high school record showing grades through the junior year, a listing of courses in progress in the senior year, a rank in class based on at least three years of high school study, scores on the Scholastic Aptitude Test (SAT), and a specified curriculum or program of study to which admission is sought.* The secondary school transcript should include the percentage of graduates attending four-year colleges.

Applicants from North Carolina must have a freshman Predicted Grade Average (PGA) of at least 1.6 in addition to adequate high school preparation in order to be admitted to a given curriculum. This PGA is computed using a formula which takes into consideration the curriculum to which the applicant is requesting admission, his rank in his graduating class and scores on the SAT (generally the SAT's should be no less than 800). The rank in class carries greater weight in this prediction than do the SAT scores. A 1.6 grade average is the equivalent of a "C" minus average on a grading scale where a 4.0 is an "A" average and a 2.0 is a "C" average.

Applicants are accepted on either junior or senior year SAT scores, although senior year scores are generally recommended, especially if the

* Students changing high schools must have at least one full semester at the last school attended before the rank is accepted.

applicant is also applying for financial aid. *An interview is not required* and does not weigh in the admissions decision.

North Carolina State University does not have a specific early decision plan for applicants now in high school. All applications are acted upon as soon as complete admission credentials are received.

1969-70 FRESHMAN CLASS PROFILE

Of the freshmen who enrolled in September, 1969, 65 percent ranked in the top fifth and 90 percent in the top two-fifths. Three percent fell in the bottom half, however, they possessed outstanding SAT scores. The average SAT-Verbal score for this class was 505 and the average SAT-Math score, 580. Over 90 percent of these freshmen had verbal scores exceeding 400 and math scores exceeding 470.



The freshman orientation program is designed to acquaint new students with the academic, extracurricular and social life at NCSU.

HIGH SCHOOL PREPARATION

An applicant's secondary school preparation should emphasize the traditional academic subjects. The following high school preparation, or its equivalent is required.

	ENGLISH	MATHEMATICS	FOREIGN LANGUAGE	SCIENCES	SOCIAL STUDIES	RECOMMENDED ACHIEVEMENT TESTS
AGRICULTURE	4	3 ----- Biological and Agricultural Engineering 4	Two years of a single language required for <i>Liberal Arts</i> and strongly recommended for curricula stated below.	Two years including biology and either chemistry, physics, or advanced biology as indicated below.	Two years required for all schools. One must be U. S. History.	The January test date during the senior year is strongly recommended. <i>Mathematics Level I should be taken by all entering freshmen.</i> Additional tests as indicated below.
DESIGN	4	4	Biological Sciences	Chemistry, Advanced Biology, or both	2	Biology and/or Chemistry European History and World Cultures ----- Foreign Language for students entering the biological sciences and have two years of a single language.
EDUCATION	4	3 ----- Mathematics and Science Education 4		Physics Chemistry and/or Physics for students entering Science Education.	2	Physics Chemistry and/or Physics for students entering Science Education.
ENGINEERING	4	4		Chemistry and/or Physics	2	Chemistry and/or Physics European History and World Cultures
FOREST RESOURCES	4	4		Chemistry and/or Physics	2	Chemistry and/or Physics
LIBERAL ARTS	4	3	Two years of a single modern foreign language (Spanish, French, German or Russian).	One other science	2	English and/or European History and World Cultures and/or Foreign Language
PHYSICAL SCIENCES AND APPLIED MATHEMATICS	4	4	Physics, Chemistry, Applied Mathematics, Geology and Experimental Statistics	Chemistry and/or Physics	2	Chemistry and/or Physics, European History and World Cultures Foreign Language for students entering physics, chemistry, applied mathematics, geology and experimental statistics.
TEXTILES	4	4		Chemistry and/or Physics	2	Chemistry for Textile Chemistry, Physics for Textile Technology.

SCHOLASTIC APTITUDE TEST (SAT)

Applicants for admission as freshmen must take the College Entrance Examination Board Scholastic Aptitude Test (SAT) and request that their scores be sent directly from the Board to North Carolina State University (Code #-R5496).

These tests are given several times a year at a number of centers throughout the United States and in foreign countries. Application forms and information booklets may be obtained from your guidance counselor or by writing to:

College Entrance Examination Board
Box 592
Princeton, New Jersey 08540

Applications are due in the board office well in advance of the test dates. Prospective students should obtain full information early enough to assure that proper application for the test is made.

ACHIEVEMENT TESTS

Each admitted freshman, for best placement, should take one or more Achievement Tests (afternoon testing), depending upon his curriculum and the courses he plans to take. The January test date during the senior year in high school is strongly recommended.

Mathematics Level I should be taken by all entering freshmen. For students in engineering, physical and mathematical sciences and other curricula in which mathematics is a major part, it is helpful in identifying those who may be ready to enroll in Analytic Geometry and Calculus instead of Algebra and Trigonometry.

Correct placement permits a student to begin at his present level so that he neither finds himself lost in material beyond his understanding nor has to repeat subject matter previously learned. Frequently, such placement means faster progress toward graduation. A student scoring sufficiently high will qualify for credit in some subjects as well as for advanced placement.

A student who fails to take the Achievement Test(s) will be placed in a beginning level course(s) which in some instances allows no credit toward graduation. Although such placement may be to the advantage of a weaker student, it often results in unnecessary delay for the better student.

ADVANCED PLACEMENT

Advanced placement is offered to those who, because of their demonstrated abilities, are qualified to accelerate their studies. To obtain advanced placement at least three options are available. The student may take a proficiency examination in a subject when he believes that he has mastery of the course material; application for such an examination must be made to the head of the department in which the subject is offered. Secondly, advanced placement and credit is given for satisfactory performance on the subject matter proficiency tests of the College Entrance Examination Board's Advanced Placement Program. Finally, the entering

student may be selected for an advanced section in mathematics, a foreign language or history on the basis of his previous academic record and his performance on the College Board aptitude and achievement tests or other examination. In addition, based on a predicted grade in English, a student may be given the opportunity to enroll in English 112, the second semester of freshman English, during his first semester on campus. The PGE (predicted grade in English) is based on the high school record and SAT scores. A "C" or better earned in English 112 would give the student a total of six hours of credit; three hours of credit for English 112 plus three hours of credit for English 111, the first semester course which was bypassed.

OUT-OF-STATE STUDENTS

Undergraduate applicants from outside North Carolina must generally meet higher standards than required of North Carolina residents before admission will be granted. North Carolina State University is limited to accepting not more than 15 percent of total undergraduate admissions from outside the State.

TWO-YEAR AGRICULTURAL INSTITUTE

Any student who has received a diploma from an accredited high school or has passed the high school equivalency examination administered by the State Department of Public Instruction is eligible for consideration for the Agricultural Institute. Each application must be reviewed and evaluated by the institute director. The application should include a copy of the applicant's high school record or a letter indicating the applicant has passed the equivalency examination.

Also, the applicant must have a letter of recommendation sent to the Admissions Office by a responsible citizen, not a relative, attesting to the student's integrity and character. The Scholastic Aptitude Test is not required of applicants to the Agricultural Institute.

TRANSFER STUDENTS

North Carolina State University welcomes transfer applicants. In recent years more than 25 percent of our graduates started their college programs at other institutions.

All transfer applicants must have an overall "C" average on all college-level work taken at accredited institutions and must be eligible to return to the last institution regularly attended. Applications of students from nonaccredited institutions will be reviewed by the Admissions Committee.

Work completed at technical institutes is generally not considered college level; after enrolling at North Carolina State University, however, students from such institutes may take comprehensive examinations in courses for which they feel their previous training qualifies them for advanced placement.

Transfer students must present at least 28 semester hours of "C" work or must meet admissions requirements for entering freshmen. *Out-of-state* students should be prepared to meet higher standards especially in design,

engineering, liberal arts, and physical and mathematical sciences.

If admitted, the prospective transfer student's record will be further evaluated to determine the amount of credit that can be transferred and applied toward degree requirements at North Carolina State University. This evaluation will be approved by the dean of the school in which the student wishes to enroll. **Transcripts are not evaluated however until the applicant has been admitted.** A nonrefundable \$2 transcript evaluation fee, payable to North Carolina State University, is charged for this service.

Students eligible to continue at other campuses of the Consolidated University of North Carolina may transfer to North Carolina State University so long as their cumulative grade point averages are 2.0 or above or their quality point deficiencies do not exceed 25 and their previous academic work is judged to be satisfactory and appropriate for the curriculum requested at North Carolina State University. (Refer to section on Retention-Suspension Rules, pages 38-39.)

Students who transfer to North Carolina State University from another campus of the Consolidated University of North Carolina will receive credit for work passed and grades and quality points for all courses taken at the other campus.

UNCLASSIFIED STUDENTS

An unclassified student is one who has been approved for admission to a specific school and is earning college credit but has not chosen a specific curriculum. Unclassified students must meet the same admissions requirements as regular students. If, at a later date, an unclassified student wishes to change to regular status, his credits must be evaluated for his chosen curriculum.

SPECIAL STUDENTS

The special student classification is primarily designed for students 21 years of age or older who are professionally employed in the Raleigh area, housewives wishing to take courses for self-improvement, and other mature individuals interested in college courses for special reasons but who do not desire to work toward a degree at North Carolina State University. The usual college admissions requirements may be waived for qualified special students, but regular rules of scholarship will apply after admission. A maximum of seven hours per semester may be taken by students in the special classification. The special student may not represent North Carolina State University in any intercollegiate contest or become a member of any fraternity—professional or social.

Application as a special student should be made through the Division of Continuing Education, Room 134, 1911 Building. If special students wish to change to regular status at a later date, they must make regular application and meet the same admissions requirements as other degree candidates.

AUDITOR

New students desiring admission as auditors should apply through the Division of Continuing Education. The participation of auditors in class

discussion and in examinations is optional with the instructor. Auditors receive no college credit; however, they are expected to attend classes regularly.

USAFI CREDITS

College-level courses offered by accredited institutions and made available to military personnel through the United States Armed Forces Institute will be considered for transfer credit if a grade of "C" or better has been earned and if the courses are applicable to the student's curriculum. A transcript must be sent to the Office of Admissions directly from the institution offering the course.

Military personnel are encouraged to investigate the possibility of college credit through the College Level Examination Program. This CLEP has been developed by CEEB to enable those who have reached the college level of education outside of the traditional classroom experiences to demonstrate their achievement and to use test results for college credit.

CLEP includes two kinds of examinations—the general examinations and the subject examinations. The subject examinations measure achievement in specific college courses and are of more value credit wise than the general exams.

READMISSION OF FORMER STUDENTS

To be readmitted after having withdrawn from this University or having been out of school for one or more semesters, the student must be academically eligible to return and should apply to the Readmissions Office, Department of Registration and Records, 11 Peele Hall, for re-admission at least 30 days prior to the date of desired enrollment.

GRADUATE STUDENTS

All students working toward graduate degrees or who are taking courses for graduate credit which are to apply ultimately to a graduate degree are enrolled in the Graduate School. Procedures and policies governing graduate admission are outlined in a special catalog issued by the Graduate School. Any student interested in enrolling for graduate study may obtain a copy of the Graduate School Catalog from:

Dean of the Graduate School
Peele Hall
North Carolina State University
Raleigh, North Carolina 27607



The last two steps of registration, completing registration cards and obtaining previously prepared class schedules, take place at Reynolds Coliseum.

Registration

PREREGISTRATION

Preregistration is a procedure whereby a student meets with his adviser to discuss his academic program and to select the courses he will take during the next semester. The courses selected by each student are processed through the computer which will assign a day and an hour for each course requested. During the registration period at the beginning of each semester, the student is able to obtain his completed schedule. Each student is provided a schedule of courses booklet each semester. This booklet contains all necessary instructions for completing preregistration.

REGISTRATION

Registration consists of three steps: (1) paying tuition and fees (preferably by mail); (2) completing registration cards; (3) obtaining previously prepared class schedules. (Instructions for completing registration are issued each semester.)

LATE REGISTRATION

Students who preregister or register late must follow late registration instructions and pay the required late fees. (Instructions for completing late registration are issued each semester.)

INTERINSTITUTIONAL REGISTRATION

Students enrolled full-time at N. C. State University may take course work at one of the Raleigh colleges, at a branch of the Consolidated University of North Carolina or at Duke University. Interinstitutional registration forms and all regulations and procedures are available from the Department of Registration and Records. (See the section on Co-operating Raleigh Colleges, page 51.)

CREDIT-ONLY COURSE REGULATIONS

Each undergraduate student will have the option to register and to count toward graduation requirements a total of up to 12 semester hours in the category of credit-only courses. The student may select as "credit-only" any course offered by the University, excepting the several courses in Military Science and Air Science. The selected courses must be included under the free elective category of the specific curriculum in which the student is enrolled. He will be placed in a regular section and will be responsible for attendance, assignments and examinations. The student's performance in a credit-only course will be reported as "CR" (passing grade for credit-only course) or "NC" (no credit; failing grade for credit-only course) and will not affect his grade point average. A passing grade (CR) will allow the course credit to be counted toward the student's graduation requirements. D-level work (passing work) is considered an adequate basis for awarding credit (CR) if the instructor is otherwise satisfied with the student's class participation, attitude, attendance, etc.

SCHEDULE CHANGES—DROPS AND ADDS

Courses may be added during the first week of a regular semester; courses may be dropped during the first two weeks of a semester with the result that they will not appear on the student's record. Beyond this period courses may be dropped as follows:

1. During third and fourth weeks, with adviser's approval, a grade of "W" is recorded.
2. Thereafter, with the recommendation of the adviser and the approval of the dean, for compelling reason, a grade of "W" is recorded. If the drop is not approved by both adviser and the dean, a grade of "FD" is recorded.

NOTE: If a student is enrolled for only one course and wishes to drop it, the procedure is that of withdrawal from the University.

WITHDRAWAL FROM THE UNIVERSITY

If a regularly enrolled student wishes to withdraw from the University (dropping all courses) during a semester or summer session, he must go to the Counseling Center to initiate the official withdrawal process. Parents' approval must be obtained for a student under 21.

Determination of grades and the entry on the permanent record for a student withdrawing during a semester depend upon his reasons for withdrawal, the time of withdrawal in the semester, and his standing in his courses at the time of withdrawal. A student who discontinues attendance in all classes without officially withdrawing will receive all "FD" grades.

A student who withdraws after the first two weeks of classes will not receive any refund of tuition and fees, except in unusual cases approved by the Refund Committee.

CHANGES IN CURRICULUM

Students may change from one curriculum to another by filing with the Department of Registration and Records a curriculum change form signed by the deans or directors of instruction concerned.

Tuition and Fees

Charges for tuition and fees vary according to (1) the student's status as a resident or nonresident of North Carolina; (2) type of student (regular undergraduate, special or unclassified undergraduate, auditor or graduate student); and (3) to a minor degree, the curriculum in which the student is enrolled.

An application for admission must be accompanied by an application fee of \$10.

Individual statements for tuition and fee charges will be mailed five or six weeks before the beginning of the semester. Tuition and fees are payable in full before the first day of classes. All charges are subject to change without notice, but the charges in effect currently are as follows:

REGULAR UNDERGRADUATE STUDENTS—TUITION AND FEES

<i>Schools</i>	<i>In-State Students</i>		<i>Out-of-State Students</i>	
	<i>Fall Semester</i>	<i>Spring Semester</i>	<i>Fall Semester</i>	<i>Spring Semester</i>
Agriculture and Life Sciences	\$211.00	\$210.00	\$573.50	\$572.50
Design	\$211.00	\$210.00	\$573.50	\$572.50
Education	\$211.00	\$210.00	\$573.50	\$572.50
Engineering	\$211.00	\$210.00	\$573.50	\$572.50
Forest Resources	\$216.00	\$215.00	\$578.50	\$577.50
Liberal Arts	\$211.00	\$210.00	\$573.50	\$572.50
Physical and Mathematical Sciences	\$211.00	\$210.00	\$573.50	\$572.50
Textiles	\$211.00	\$210.00	\$573.50	\$572.50

RESIDENCE STATUS FOR TUITION PAYMENT

General—The tuition charge for legal residents of North Carolina is less than for nonresidents. To qualify for in-state tuition, a legal resident must have maintained his domicile in North Carolina for at least the six months next preceding the date of first enrollment or reenrollment in an institution of higher education in this State.

Minors—The legal residence of a person under 21 years of age at the time of his first enrollment in an institution of higher education in this State is that of his parents, surviving parent or legal guardian. In cases where parents are divorced or legally separated, the legal residence of the father will control unless custody of the minor has been awarded by court order to the mother or to a legal guardian other than a parent. No claim of residence in North Carolina based upon residence of a guardian in North Carolina will be considered if either parent is living unless the action of the court appointing the guardian antedates the student's first enrollment in a North Carolina Institution of higher education by at least 12 months.

A minor student whose parents move their legal residence from North Carolina to a location outside the State shall be considered to be a non-resident after six months from the date of removal from the State.

For the purpose of determining residence requirements under these rules, a person will be considered a minor until he has reached his 21st birthday. Married minors, however, are entitled to establish and maintain their residence in the same manner as adults. Attendance at an institution of higher education as a student cannot be counted as fulfilling the six-month domicile requirement.

Adults—A person 21 years of age or older is eligible for in-state tuition if he has maintained continuous domicile in North Carolina for the six months next preceding the date of enrollment or reenrollment, exclusive of any time spent in attendance at any institution of higher education. An in-state student reaching the age of 21 is not required to reestablish residence provided that he maintains his domicile in North Carolina.

Married Students—The legal residence of a wife follows that of her husband, except that a woman currently enrolled as an in-state student in an institution of higher education may continue as a resident even though she marries a nonresident. If the husband is a nonresident and separation or divorce occurs, the woman may qualify for in-state tuition after establishing her domicile in North Carolina for at least six months under the same conditions as she could if she were single.

Military Personnel—No person shall be presumed to have gained or lost in-state residence status in North Carolina while serving in the Armed Forces. However, a member of the Armed Forces may obtain in-state residence status for himself, his spouse, or his children after maintaining his domicile in North Carolina for at least the six months next preceding his or their enrollment or reenrollment in an institution of higher education in this State.



The first nuclear reactor ever used for educational purposes was housed in Burlington Nuclear Laboratories.

Aliens—Aliens lawfully admitted to the United States for permanent residence may establish North Carolina residence in the same manner as any other nonresident.

Property and Taxes—Ownership of property in or payment of taxes to the State of North Carolina apart from legal residence will not qualify one for the in-state tuition rate.

Change of Status—The residence status of any student is determined as of the time of his first enrollment in an institution of higher education in North Carolina and may not thereafter be changed except: (a) in the case of a nonresident student at the time of his first enrollment who, or if a minor his parents, has subsequently maintained a legal residence in North Carolina for at least six months, and (b) in the case of a resident who has abandoned his legal residence in North Carolina for a minimum period of six months. In either case, the appropriate tuition rate will become effective at the beginning of the term following the six-month period.

Responsibility of Student—Any student or prospective student in doubt concerning his residence status must bear the responsibility for securing a ruling by stating his case in writing to the admissions officer. The student who, due to subsequent events, becomes eligible for a change in classification, whether from out-of-state to in-state or the reverse, has the responsibility of immediately informing the Office of Admissions of this circumstance in writing. Failure to give complete and correct information regarding residence constitutes grounds for disciplinary action.

Appeals of Rulings of Admission Officers—Any student or prospective student may appeal the ruling of the admissions officer in writing to the Chancellor of the institution. The Chancellor may use any officer or committee which he deems appropriate in review of the appeal. Appeal of the Chancellor's ruling may be made to the President of the University; such appeals to be filed with the Chancellor and forwarded by him to the President.

LATE REGISTRATION

Registration schedules are set for specific days, and certain definite procedures are outlined. A student has not completed registration until all of the required steps are taken. All students, graduate and undergraduate, who fail to register on dates scheduled must pay a late registration fee.

LESS THAN SEVEN HOURS

Undergraduate students taking one course of not more than four hours during a regular semester will be charged one-fourth tuition, one-fourth academic fees and no nonacademic fees. These students will not be entitled to any of the services and privileges provided by the non-academic fees. Undergraduate students taking five or six hours during a regular semester will be charged one-half tuition, one-half academic fees and all nonacademic fees. All other undergraduate students will pay full tuition and fees.

AUDITS

Subject to academic regulations, regularly enrolled undergraduate students may audit courses by registering for them without additional

charge. Graduate students may register for one course as an audit in any semester without charge when the audit is certified by the Dean of the Graduate School as a part of course work for which tuition charges are made. (This does not apply in the summer sessions.)

GRADUATE STUDENTS

Applicants interested in graduate work may receive a schedule of fees upon application to the Graduate School.

COMMENCEMENT FEE

A fee of \$12.00 covering cost of diploma and rental of cap and gown, is charged candidates for the baccalaureate degree during the last semester before the degree is awarded.

GENERAL DEPOSIT

As partial security for library books, property repair charges, physical education property, laboratory breakage, etc., a general deposit of \$25.00 must be paid by every student at the time of his first enrollment. These miscellaneous charges will be deducted from the general deposit as incurred during the period of one's study. The general deposit must be rebuilt to the \$25 level by the student whenever the deposit has been depleted.

The general deposit of \$25 or the remaining balance is refunded when a student has completed the requirements for a degree or has permanently

Harris Cafeteria is conveniently located near the major dormitories on the campus.



withdrawn from the University. The student is responsible for applying for the refund and providing the Office of Business Affairs with a correct mailing address. Refund will be made by check approximately 30 days after the student terminates his residence at the University.

PROFESSIONAL STUDENTS

Students in the various fifth-year professional curricula will be charged on the same basis as undergraduate students.

BOOKS AND SUPPLIES

The cost for books and supplies is variable, depending upon the curriculum in which the student is enrolled. A reasonable estimate is \$180 per year, but students who require drawing supplies and slide rules have an additional original outlay. All books and supplies must be paid for in cash as purchased.

ESTIMATED ANNUAL COST

Items such as tuition, fees and room rent in residence halls are fixed costs. Other items are variable with the individual students.

	<i>Fall Semester</i>	<i>Spring Semester</i>	<i>Annual Total</i>
Tuition—North Carolina Residents	\$112.50	\$112.50	\$225.00
(Out-of-State Residents)	475.00	475.00	950.00
Other University Fees	98.50	97.50	196.00
General Deposit (paid at first enrollment only)	25.00	—	25.00
Room*	133.00	133.00	266.00
Board	315.00	315.00	630.00
Books and Supplies	90.00	90.00	180.00
Other Personal Expenses and Incidentals	140.00	140.00	280.00
TOTAL—North Carolina Residents	\$914.00	\$888.00	\$1,802.00
(Out-of-State Residents)	\$1,276.50	\$1,250.50	\$2,527.00

REFUND OF TUITION AND FEES

A student who withdraws from school on or before the first two weeks of a semester will receive a refund of the full amount paid less an enrollment fee. After the period specified, no refund will be made.

REFUND COMMITTEE

In some instances circumstances justify the waiving of rules regarding refunds. An example might be withdrawal from the University because of illness. Students have the privilege of appeal to the refund committee when they feel that special consideration is merited. Applications for such appeals may be secured from the Division of Student Affairs.

* Room rent for female occupants is \$158.00 each semester.



Student Housing

North Carolina State University strives to provide suitable accommodations for its students. The University operates 13 residence halls which house 3,952 men, two residence halls which house 800 women, one residence hall which houses 552 men and 264 women, and 300 apartments for married students.

RESIDENCE HALLS

The Student Housing Office is responsible for the operation of the University's residence halls. Each hall is staffed with selected students, both graduate and undergraduate, who are responsible to professionally trained administrative personnel. These staff members are available to assist and advise the residents in any way possible. The officers and staff of each residence hall work together with the residents to promote activities within the hall which provide valuable experiences in group living. These experiences emphasize cooperation and a mutual respect among all students living in the hall. Furthermore, by initiating, planning and carrying out such activities, they can assist each student by teaching social competence, encouraging sound citizenship through leadership and assisting the residents in acquiring mature habits and attitudes.

These residence halls provide several living arrangements. The newest buildings are arranged in suites of four or five rooms sharing a bath. The older halls have a center corridor with rooms opening on to it. The rooms are furnished with the necessary articles of furniture; however, the student should bring personal items such as bed linens, pillows and towels.

STUDENT HOUSING POLICY

Orientation to a university educational environment is an important adjustment for the new student. North Carolina State University recognizes the experience gained from residence hall group living as being of significant value in this personal development of the new student and has, therefore, adopted the following housing policy for both men and women.

Any student who has carried less than 28 hours (passed or failed at North Carolina State University or any other college or university) must reside in University housing unless (1) married and living locally with spouse, (2) living with parent or married member of his or her immediate family, (3) veteran (at least two years of active military service), or (4) 21 years of age or older. Students who qualify under one of the above exemptions must obtain written permission from the Student Housing Office to live outside University housing.

If a single undergraduate student who has carried 28 or more hours does not arrange for University housing, this will be the student's certification to the University that he or she has obtained parental permission to live outside University housing.

Applications for permission to live off campus are available from the Student Housing Office, 203 Peele Hall, Box 5505, N. C. State University,

Raleigh, N. C., 27607. Applications should be filed with the Student Housing Office at least two weeks prior to enrollment in order to allow sufficient time for processing of applications and mailing of written permission.

To be eligible for University housing one must enroll as a regular full-time student (an undergraduate must roster a minimum of 12 credit hours per semester).

ROOM RENTALS AND RESERVATIONS

Rooms in the men's residence hall rent for \$133* per semester and in the women's hall \$158* per semester. Reservation cards are mailed with the letter of acceptance for admission to the University. These reservation cards and the check for the rent must be returned to the Office of Business Affairs in accordance with the dates established by the Housing Rental Office before room assignments can be made.

REFUND OF ROOM RENT

If a room reservation is cancelled at the Housing Rental Office, Leazar Hall, in person or in writing on or before August 15th for fall semester and December 15th for spring semester (the date of cancellation is the date notification is received in that office), the rent paid will be refunded less a \$25 reservation fee, which is nonrefundable if a student is eligible to register. Between August 15th (for fall semester) and the last day to withdraw with tuition refund, and between December 15th (for spring semester) and the last day to withdraw with tuition refund, no refund will be made for any reason other than failure to register or official withdrawal from the University. During these times and for the above stated reasons, the rent paid will be refunded less the \$25 reservation fee and a daily charge of \$2.00 per day for men and \$2.25 per day for women from the first day of classes until the room is vacated. Students who fail to notify the Housing Rental Office and who fail to check in and secure their keys on or before 5 p.m. the first day of classes will have their reservation cancelled without refund.

HOUSING FOR MARRIED STUDENTS

The University operates 300 apartments (McKimmon Village) for married students. The rental is \$49 for an efficiency; \$59.50 for a one-bedroom; and \$71 for a two-bedroom, including water only. Priority in renting goes to graduate students. Information on availability and applications should be requested from the Housing Rental Office, North Carolina State University, Box 5505, Raleigh, N. C. 27607.

Raleigh has numerous privately owned apartments and houses available for rent to university students. A partial listing is located in the Housing Rental Office. No listing is published because of the rapid turnover.

The University does not operate a trailer parking area; however, privately owned parks are available within a reasonable distance of the campus.

* Currently being reviewed.



McKimmon Village contains 300 one, two or three bedroom apartments for married students.

FRATERNITIES

Each of the 17 social fraternities chartered by the University maintains a chapter house. Fraternities are under the University's supervision and are required to have a resident housemother who serves as hostess, adviser and dietitian.

Rental fees vary in fraternity houses depending upon the individual chapter but are approximately the same as the residence hall rates.



Research with plants takes place in the phytotron, a facility which provides a completely controlled environment.

Financial Aid

Entering students may gain consideration for all types of assistance by obtaining Parents' Confidential Statement forms from their high schools, having their parents complete the forms and submitting them to the College Scholarship Service in Princeton, New Jersey, preferably before February 1, of the year of expected fall enrollment. The Financial Aid Office at North Carolina State University receives from CSS a copy of the Parents' Confidential Statement and a financial need analysis report for each applicant. These data aid in determining the amount of assistance to be offered by the University.

Awards are made to applicants on the basis of financial need, good citizenship and promise of satisfactory academic achievement as indicated by their high school records and entrance test scores, or in the case of transfer students, strong academic credentials from their previous school. These awards usually offer combinations of scholarship or grant, loan and/or work-study job, depending upon the degree of need. Students who do not meet the requirements for aid on first enrollment will, if need is evident, become eligible for such help upon satisfactory completion of one of more semesters of college work.

Upperclassmen ordinarily must apply for financial aid each year. By one application the student receives consideration for all the available types of financial assistance for which he is eligible, including scholarships, loans and work assignments. Each recipient must have a satisfactory record of achievement and citizenship. Aid is made available on a nondiscriminatory basis to all qualifying students.

SCHOLARSHIPS

The scholarship awards are competitive and are given to those applicants who most nearly meet the selection criteria specified by the scholarship. In addition to high academic potential and achievement, good character and financial need, there may be various curricular, geographic and other restrictions on specific awards.

EDUCATIONAL OPPORTUNITY GRANTS

Undergraduate students who show academic or creative promise and who could not attend college without assistance are eligible. Eligible students who are accepted for enrollment on a full-time basis or who are currently enrolled in a good academic standing may receive Educational Opportunity Grants. The grants range from \$200 to \$1000 and can be no more than one-half of the total assistance given to the student.

ATHLETIC AWARDS

Athletic awards are made upon the recommendation of the Athletic Department to athletes who meet the established qualifications for such awards. A full athletic award provides tuition, fees, room, meals, books and supplies and \$15 per month for laundry and dry cleaning. Awards are available in football, basketball, swimming and track.

NATIONAL DEFENSE STUDENT LOANS

North Carolina State University participates in the National Defense Student Loan Program. In this program students who have been accepted for enrollment or currently enrolled students taking at least half-time course loads and who can demonstrate financial need may borrow up to \$1,000 each academic year to a total of \$5,000. Graduate students may borrow up to \$2,500 per year to a maximum of \$10,000. The repayment and interest period begins nine months after a student ends his studies. The loans bear interest at the rate of three percent per year and the repayment may be extended over a 10-year period, provided the payments are no less than \$15 per month. Preceding graduation or other discontinuation of studies, borrowers in this program are expected to have exit interviews with the loan officer in the Office of Business Affairs to establish a repayment schedule.

EMERGENCY LOANS

Small short-term loans are available for qualified, enrolled students to meet unexpected expenses. These loans must be repaid in 30 to 60 days and are not extended beyond the end of a term or graduation.

OTHER LOAN SOURCES

Applicants for aid judged to be eligible for the loans listed below will be referred by the Financial Aid Office.

College Foundation, Inc.—Under the Insured Loan Program, North Carolina students are eligible to apply for loans up to \$1,500 per year with an aggregate of \$7,500 for six years of study. Interest, during the in-school period, is paid by the Federal Government for students from families with adjusted incomes of less than \$15,000 per year. These loans are insured by the State Education Assistance Authority, and the students pay an insurance premium of one-half of one percent. Interest is paid by borrower during repayment period.

James E. and Mary Z. Bryan Foundation, Inc.—North Carolina students are eligible to apply for loans up to \$1,500 per year for undergraduate study, with an aggregate of \$6,000 for four years of study. Interest is at the rate of one percent per year during the in-school period and at six percent during the repayment period.

COLLEGE WORK STUDY

Students from low-income families are potentially eligible for employment by the University in on- and off-campus jobs under federally supported work-study programs. Students may work up to 15 hours weekly while attending classes full-time.

PART-TIME EMPLOYMENT

The Financial Aid Office operates an employment service for students desiring part-time work while attending school. Jobs are available on-

and off-campus and are not necessarily based on financial need. Placement is usually arranged after the student has his class schedule. Interested students should refer to the list of current job openings available at the Student Employment Office, 205 Peele Hall.

DEFERRED PAYMENT PLANS

There are several installment payment arrangements available from commercial lending agencies that are specifically designed for paying college expenses. These plans typically pay the college the amount specified by the loan agreement at the beginning of each semester. Repayment is on a monthly basis and may be extended beyond the academic year.

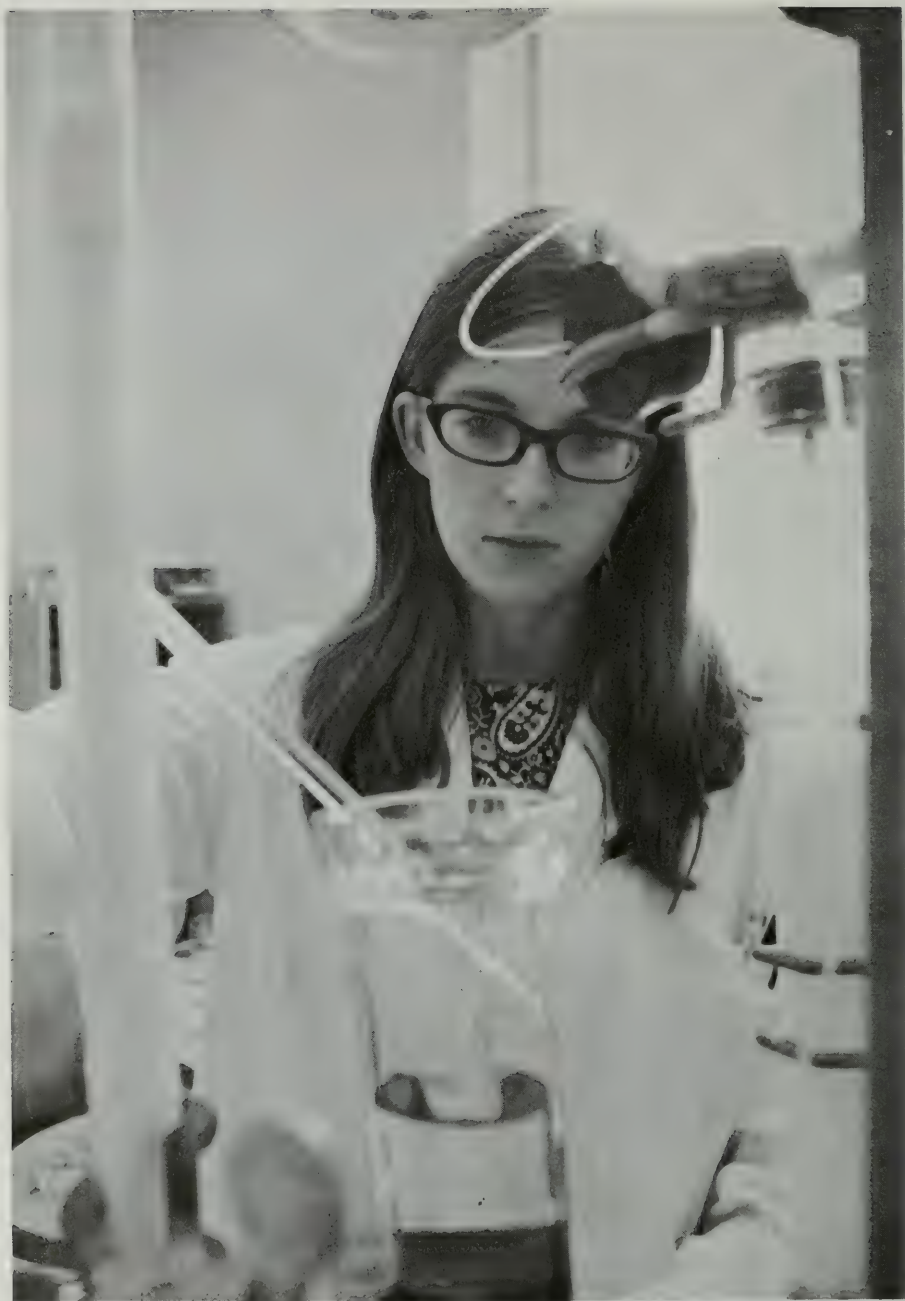
Students desiring additional information on financial matters or wishing to apply for assistance should write or visit the Financial Aid Office, 205 Peele Hall.

OUT-OF-STATE RESIDENTS

Students who are residents of states other than North Carolina, should contact the Financial Aid Office, 205 Peele Hall, regarding Government guaranteed loan plans in their states.



The recently completed Poe Hall contains a curriculum materials center, industrial arts laboratories, science laboratories, as well as child play and guidance observation rooms.



Laboratory work is an important part of study for a degree in forest resources.

Academic Regulations

QUALITY POINTS AND GRADE POINT AVERAGE

North Carolina State University uses a system of credit hours, letter grades and quality points. The semester credit hours represent the amount of work completed, the letter grades indicate the quality of the student's work and the quality points provide a means of converting letter grades to numerical averages. Four quality points are earned by undergraduate students for each hour of "A"; 3 for "B"; 2 for "C"; 1 for "D"; and none for "F". For example, a grade of B in a 3 credit hour course would earn 9 quality points for that course.

The grade point average is obtained by dividing the total number of quality points earned at North Carolina State (plus any earned at another branch of the Consolidated University) by the number of credit hours carried (passed plus failed). Credit hours transferred from outside the Consolidated University, awarded for military service, obtained by proficiency examination, or earned in certain programs or credit-only courses do not enter into the computation of the grade point average.

DEFINITION OF LETTER GRADES AND QUALITY POINT VALUES

		<i>Quality Points Per Credit Hour</i>
<i>Grade</i>		
A	Excellent	4
B	Good	3
C	Satisfactory	2
D	Poor	1
F	Unacceptable	0
FA	Unacceptable (Did not attend examination)	0
FD	Unacceptable (Dropped course)	0
FI	Unacceptable (Failed to remove incomplete)	0
S	Satisfactory	0
U	Unsatisfactory	0
CR	Passing grade for credit-only course	0
NC	No credit: Failing grade for credit-only course	0

Neither quality points nor credit hours are given for following grades:

W—Withdrew with passing grade, IN—Incomplete (temporary), LA—Later (temporary), AB—Excused from final examination (temporary), AU—Audit, NG—Poor Attendance (AU grade not given).

At the discretion of the professor, a student may be given an "Incomplete" grade for work not completed because of a serious interruption in his work not caused by his own negligence. An incomplete must be made up by the end of the next regular semester the student is in residence unless the department involved is not able to allow the make-up. In the latter case, the department will notify the student and the Office of Registration and Records when the incomplete must be made up. *The student must not register again for the course while the "IN" stands.* Any incomplete not removed during either the period specified by the department or the next

regular semester in residence will automatically become a failure and will be recorded as "FI".

A grade of "FA" is recorded for an unexcused absence from a final examination. If an absence from the examination is excused, a grade of "AB" is recorded, and the student must arrange to take the examination during the next regular semester he is in residence, or the final grade becomes "FA". *The student must not register again for the course while the "AB" stands.*

A grade of "FD" is recorded if a student has unofficially dropped a course for which he has been scheduled, or if he has officially dropped it with a failure. A failure may be made up only by repeating the subject. Such a repeat course must be regularly scheduled on the student's class schedule.

In the case where a student receives an "AB" (absent from examination) or an "IN" (incomplete) the semester just preceding his graduation, the regulations that follow will apply:

1. If the course is *not* needed for graduation, the student involved may graduate and, if he wishes to do so, may return at a later date to make up the necessary work; however, after a student graduates, his overall academic average and class rank cannot be changed.
2. If the course is needed for graduation, the student will not be allowed to graduate until the work has been made up. Upon the student's graduation, his overall academic grade point average will be computed.

GRADE REPORTS

At registration students will be asked to complete an address card which will be used to mail grade reports and other routine correspondence. Many student grade reports go to the students' parents or guardians. However, many students, because of age or marital status, elect to have their grade reports sent directly to them.

Parents and students are urged to confer with one another and arrive at a mutual understanding of the person and address to whom the grade reports should be sent. It will be assumed that information received during registration each semester will be agreed upon by all concerned.

RETENTION—SUSPENSION RULES

Undergraduate Students—A student whose cumulative grade point average is 26 or more quality points below a 2.0 grade-point average is suspended and is ineligible to continue for the next regular semester. (A 2.0 average is required for graduation in all programs of study.)

Exception Semester 2.0 Continuation Rule—A student with a quality point deficit of 26 or more who earns at least a 2.0 average for a regular semester will not be suspended at the end of that semester but will be continued on Provisional Status.

A student with a quality point deficit of 26 or more who is eligible to continue on the basis of a 2.0 average for his last regular semester must maintain, if he attends one or both summer sessions, a 2.0 average for each summer period attended in order to retain his eligibility to continue. In other words, a student who increases his quality-point-deficiency during either summer session will lose his eligibility to continue under the

"Semester 2.0 Continuation Rule" and will not be eligible to register for a regular semester (1) unless he is approved by the admissions committee or (2) until by correspondence course work and/or subsequent summer session work he reduces his quality-point-deficiency to 25 quality points or less.

Students with cumulative grade point averages lower than 2.0 will have the amount of quality-point-deficiency noted on each grade report.

A suspended student may appeal to the Admissions Committee for special consideration of extenuating circumstances.

Graduate Students—Any graduate student who falls below a 3.0 average is placed on probation and should see his department head or departmental graduate administrator promptly. If allowed to continue, and if a 3.0 average is not achieved after an additional semester, an appointment with the Dean of the Graduate School must be made promptly. Also, any graduate student receiving a "U" grade must see the Graduate Dean.

REPEATING COURSES

A student who repeats a course previously taken (passed or failed) will have both grades counted in his cumulative grade point average. If he passes the course both times, the credits will be counted only once toward the required number of credits for graduation.

A student's eligibility to repeat a course previously passed shall be determined by his adviser.

AUDITS

A student wishing to audit a course must have the approval of his adviser and of the department offering the course. The participation of auditors in class discussion and in examinations is optional with the instructor. Auditors receive no credit; however, they are expected to attend classes regularly.

REEXAMINATIONS

Any student who fails a course within two semesters of graduation and who fails only one course during that semester may apply to the Office of Registration and Records for permission to remove that failure by standing a reexamination on the total subject matter of the course. For this regulation, summer school counts as a semester. If he fails that reexamination, he is not eligible for another reexamination in that course. If he fails more than one course during the next to the last semester, he cannot take a reexamination that semester; but if he subsequently removes all but one of these deficiencies by repeating the course or courses, has had no other reexamination, and has completed all other degree requirements, he may apply at the end of his last semester in residence for permission to take a reexamination. Eligibility to take a reexamination will be determined by the Office of Registration and Records.

When such a reexamination is taken to remove an "F", only the re-examination grade will be counted. A senior who has passed a re-

examination will have his grade for that course changed from "F" to "D", which will affect his cumulative grade point average. A fee of \$5 is charged for administering such a reexamination. If a student takes a reexamination, fails it, and subsequently audits the course, he cannot take another reexamination, but may apply for "credit by examination," which carries no grade.

SEMESTER LOAD AND SPECIAL REQUIREMENTS

The maximum load for a semester is 21 hours. To carry more than 21 hours requires consultation with the adviser and approval by the dean or director of instruction. Permission is granted only under extenuating circumstances. A student on Provisional Status is limited to a load of 15 hours, unless approval for a heavier load is secured from his adviser.

For a six-week summer session a student must have the same approval if he carries more than seven hours. Veterans or other students receiving federal educational benefits must meet the work load requirements of the appropriate federal agency.

Audits in subjects in which the student has had no previous experience are evaluated at full credit value in determining course load. Audits taken as repetition of work previously accomplished are considered as one-half their credit value in calculating course load.

Freshman English—English 111 and 112 must be scheduled in successive semesters until these required courses are completed satisfactorily. Students must earn a grade of "C" or better in one of the two courses. Those students who qualify for advanced placement on the basis of previous academic record and performance on the College Board Scholastic Aptitude Test will be given opportunity to enroll in English 112H. If such students earn a grade of "C" or better in the course, six hours of credit will be allowed, covering both courses. (Also, see section on Credit by Examination.)

Two-Year Physical Education Requirements—Each student is expected to schedule the required freshman and sophomore physical education courses every semester until these courses are passed satisfactorily. Any student who, for medical reasons, cannot participate fully in physical education should bring an explanatory letter from his family physician to present to the Student Health Services at orientation time.

CREDIT BY EXAMINATION

A currently registered undergraduate student desiring to take an examination for course credit in lieu of enrolling must initial the request with his adviser (except when a teaching department initiates group testing of beginning students for placement purposes and grants credit). Should the adviser approve, the student must arrange for the examination with the department offering the course. The department may administer the examination in any manner pertinent to the materials of the course. The academic standards for credit by examination will be commensurate with the academic standards for the course.

If the student exhibits satisfactory performance on the examination, the instructor will notify the Office of Registration and Records. If the



Outdoor concerts by NCSU bands and choirs are an enjoyable part of the campus in the spring.

student fails, no action beyond notifying the student is required. The Office of Registration and Records will enter the appropriate number of credit hours on the students permanent record and will issue a grade report as for courses taken in residence. Credits earned in this manner are considered in the same way as transfer credits and are not used in the computation of the student's grade point average.

READMISSION OF FORMER STUDENTS

A former student returning is one who: (a) was not in attendance during the regular semester immediately prior to the semester or summer session in which he seeks to return; (b) withdrew from the University during a fall or spring semester or during a summer session. All former students returning, both graduates and undergraduates, must complete applications for readmission.

Regulations:

1. A student who was eligible to continue at N. C. State at the time of his leaving is eligible to return even though his quality point deficiency exceeds the maximum of 25 (except as indicated in (a) and (b) immediately below). Students in this category need only complete a readmission form.
 - a. A student who was eligible to continue at the time of his leaving but who has subsequently taken work at another institution and earned less than a "C" average on such work must complete a readmission form and write a letter of petition to the Admissions Committee.
 - b. A student eligible to continue at the time of his leaving who has subsequently taken correspondence and/or extension work through N. C. State or work at another branch of the Consolidated University and earned grades which result in suspension must write a letter of petition to the Admissions Committee and complete a readmission form.
2. Suspended Students—A suspended student is eligible to attend summer school and take approved correspondence courses to improve his academic standing and will be eligible for readmission when he reduces his deficiency to 25 quality points or less. There is no limit on the number of summer school periods open to a student who is trying to earn readmission. A student who was suspended under former retention-suspension regulations but whose overall deficiency is less than 26 quality points is eligible for readmission provided he has not subsequently taken work at another institution and earned less than a "C" average on such work.
3. Letter of Petition—The Admissions Committee will give consideration to petitions from suspended students when there are extenuating circumstances. A letter of petition should be written by the student to the Admissions Committee stating:
 - a. the reason for his academic difficulty
 - b. the reasons why he believes he can now be successful in meeting the University's academic standards.

DEAN'S LIST

A full-time undergraduate student who earns a semester average of 3.0 or better on 12 or more hours of course work for which quality points are earned is placed on the Semester Dean's List. This achievement is noted on the student's grade report and permanent academic record. Also, news stories on the Semester Dean's List are distributed to hometown newspapers.

CLASSIFICATION OF STUDENTS

Students are classified at the beginning of the fall semester each year and retain that classification until the following classification period. The required number of hours for each classification is as follows:

<i>Classification</i>	<i>Semester Hours of Earned Credit</i>
Freshman	Less than 28
Sophomore	28 or more, but less than 60
Junior	60 or more, but less than 92
Senior	92 or more
Professional (School of Design)	134 or more

Agricultural Institute students are designated as first and second year students. Until an Agricultural Institute student has received a total of 28 semester credits he is classified as a first year student.

Unclassified students are those who are working for college credit but who are not enrolled in a degree-granting program. Admission as an unclassified student requires the recommendation of the dean of the school in which the student wishes to enroll. Unclassified students must meet the same entrance requirements as regular students and must meet the same requirements to continue.

Special undergraduate students in the various schools are non-degree candidates carrying seven hours or less in a semester. Special undergraduates must meet the same academic requirements as regular students in order to continue during a regular semester. Special students on the graduate level are non-degree candidates who may not earn more than six hours in this classification.

GRADUATION REQUIREMENTS

A student is scholastically eligible for graduation when he has satisfied all the specific requirements of his department, his school and the University, and has earned at least a 2.00000 cumulative average.

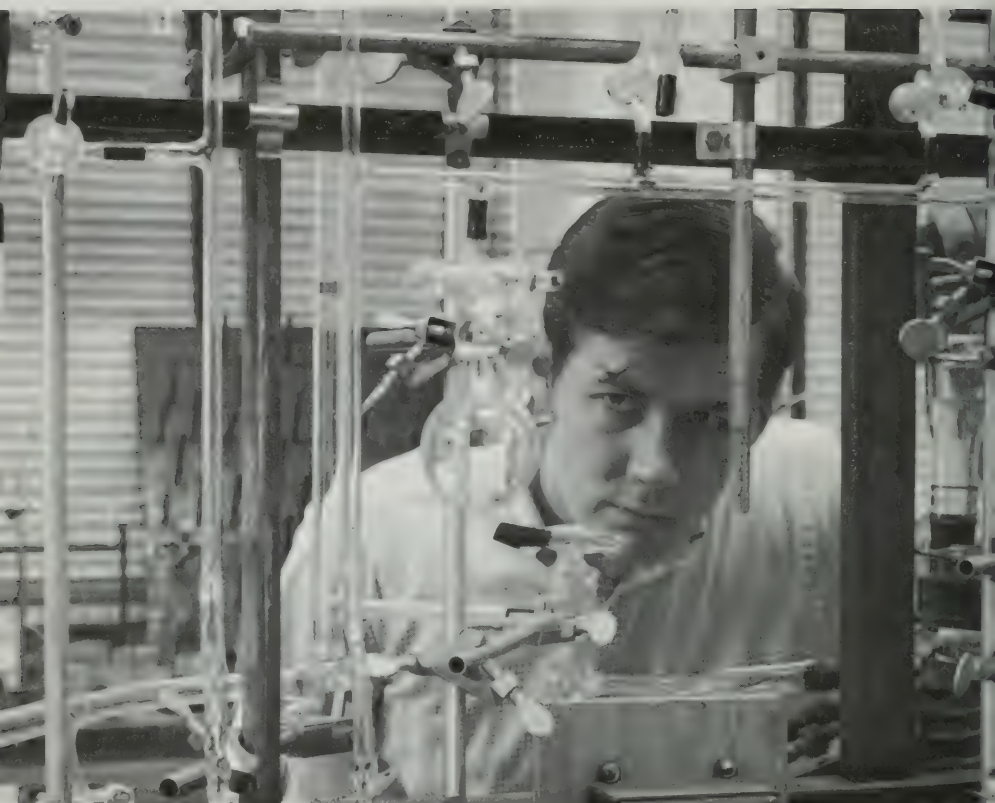
To complete requirements for a bachelor's degree, a student may take a maximum of six hours at another institution or six hours by correspondence after his last residence at North Carolina State University.

Not more than 33 hours earned by correspondence may be applied toward fulfillment of the requirements for a bachelor's degree; however, based on its own requirements, each school may limit hours earned by correspondence.

To be graduated with honors or high honors, a student must have attained a 3.0 or a 3.5 grade point average respectively on all semester hours of work considered in computing his average.

To be eligible for a bachelor's degree, a transfer student must earn at least 24 of his last 30 hours of credit in residence on this campus.

Students who have satisfactorily completed the requirements for more than one bachelor's degree may, upon the recommendation of their dean and payment of an additional diploma fee, be awarded two bachelor's degrees at the same or at different commencement exercises. To earn two degrees the student registers in one school or department and, with the cooperation of the second school or department, works out his program to cover the requirements for both.



Studies in new polymers are one phase of study for a chemical engineering graduate student.

ELIGIBILITY TO CONTINUE (Graduates)

Graduate students are expected to maintain at least a 3.0 average. Any graduate student who falls below a 3.0 average is placed on probation and should see his department head or departmental graduate administrator promptly. If allowed to continue, and if a 3.0 average is not achieved after an additional semester, an appointment with the Dean of the Graduate School must be made promptly.

OPPORTUNITIES FOR SUPERIOR STUDENTS

Optional programs of advanced course placement for underclassmen are offered by the departments of chemistry, English, history, mathematics, modern languages and physics. Honors programs for upperclassmen in agriculture and life sciences, engineering, forestry, liberal arts, and physical and mathematical sciences, as well as a program in undergraduate research participation, are available to selected students. See page 144 for more detailed information concerning the Engineering Honors program.

The D. H. Hill Library

Library facilities at North Carolina State University include the main D. H. Hill Library and special libraries for the Schools of Design and Textiles. The collections, totaling more than 500,000 volumes, have been carefully assembled to serve the educational and research programs of the University.

The D. H. Hill Library contains particularly strong research holdings in the biological and physical sciences, in all fields of engineering, agriculture and forestry. The 6,000 volume Friedrich F. Tippmann collection in the field of entomology and related biological sciences is one of the outstanding collections in the country. The collection of books and journals in the humanities and social sciences is especially helpful to undergraduate students.

The library's comprehensive collection of scientific journals emphasizes the major teaching and research interests at State; approximately 6,500 journals are received regularly. A large collection of state and federal government publications further strengthens the library's research material. The D. H. Hill Library is a depository for publications of the Atomic Energy Commission and the Food and Agricultural Organization of the United Nations, and has been a depository for U. S. federal documents since 1923.

The Textiles Library, located in Nelson Textile Building, contains outstanding holdings in the field of textiles and textile chemistry. It is regarded as one of the best textile libraries in the country. The School of Design Library, in Brooks Hall, has a very fine collection of books, journals and slides in the areas of architecture, landscape architecture and product design.

As a further aid to graduate and faculty research the library participates in an interlibrary loan program with the University of North Carolina at Chapel Hill, Duke University, Research Triangle Institute, IBM, Chemstrand, the Division of Environmental Health Services and the N. C. State Library in downtown Raleigh. A bus, arriving at State daily Monday through Friday, makes resources from these seven libraries available to State students and faculty. Among the materials available are approximately 14,000 scientific periodicals.

The present D. H. Hill Library building and the Erdahl-Cloyd Union are being remodeled for expanded library seating and open shelf collections and an 11-story addition constructed between the two buildings. The enlarged library complex will provide bookstacks for a 1,000,000-volume book collection, a large open-shelf collection and greatly expanded research facilities, including carrels and study areas.

Among the many services offered by the library are orientation tours for faculty and graduate students, and also lectures on library use to all new students. Comprehensive reference service is available almost all the hours the library is open. A variety of microtext readers and printers in the library and an extensive microfilm collection provide access to much



*The carpet tufting machine is one of many fine facilities available to students
in the School of Textiles.*

important research material. A music listening room is equipped with listening machines for playing taped recordings. One of the most widely used services in the library is the Photocopy Service. Coin-operated machines plus two machines operated by staff, provide a wide variety of photocopy service, including copy from microfilm. Machines may be used all hours the library is open.

General Information

LAUNDRY

The University operates a modern laundry and dry cleaning facility on campus at reasonable prices. Branch offices are located in the residence halls for the convenience of the students.

LINEN AND BLANKET RENTAL

The linen service provides for the initial issues of two sheets, one pillow case and three towels. The student may exchange his linen weekly at a cost of \$25 per year. Pillows may be rented for \$1.50 per year. A regular blanket rents for \$3 per year, and the N. C. State monogrammed blanket rents for \$5. These services are available to both on- and off-campus students. Application forms for these services will be mailed to each student.

Refunds under the linen rental plan are computed on a semester basis. During a semester, refunds will be computed at a charge rate of 65 cents for each week the plan has been in use, plus a \$2 service charge until \$10 is exhausted. Refunds are not available for the weeks a student fails to exchange linen.

FOOD SERVICE

Food service is provided in Harris Cafeteria and the Erdahl-Cloyd Union. Service will also be provided in the new University Center when completed.

Cost depends on the individual's requirements and the selection of food. A typical student paying cash for each meal will spend approximately \$3.15 per day or \$718 for the academic year. Board plans are available at a substantial reduction from the cash prices. Under the board plan, the student may select any items from the menu on the cafeteria line within the established meal allowances. These plans provide for wholesome well-balanced meals and are available on a yearly or semester basis.

AUTOMOBILES

Only those freshmen who are married and residing locally with spouses, those living in homes of parents or those physically handicapped will be permitted to register or park a four-wheeled motor vehicle on the University campus at any time. Each freshman is reminded that giving any false information regarding registration of motor vehicles or allowing another student to register a vehicle for him will be a direct violation of the Honor Code of North Carolina State University.

For the purpose of traffic rules and regulations, the campus is defined to include all University property adjoining or contiguous to the main campus (McKimmon Village and Fraternity Court included).

CAREER PLANNING AND PLACEMENT CENTER

The University realizes the desirability of helping the students decide what kind of an education is best suited to his or her career plans, as well as how this education can best be put to use in employment. The function of the University Career Planning and Placement Center is to fulfill this responsibility through assisting students with career planning and the implementation of career goals.

The Career Planning and Placement Center offers assistance to all students at North Carolina State University at all degree levels, and this service is available on a year round basis. Advice on the relationship of personal career goals to various programs of study and assistance in the identification of individual aptitudes and abilities affecting career potential are available to students. Aptitude and interest testing is a service provided by the Counseling Center to which students are often referred in the initial stages of their career planning. Students are urged to take advantage of the career planning service in the early years on campus in order to identify their career potential and to make optimum educational decisions.

In addition this office arranges and coordinates job interviews between students and employer representatives. In their senior year students are urged to use this placement service for interviewing with potential employers. The staff will also recommend contacts with employers not scheduled to visit the campus, and will advise students of job opportunities given to the center by mail or telephone.

Representatives of business, industry, government and education come from throughout the country to interview North Carolina State University students. Typically about 800 employers will conduct approximately 10,000 interviews a year on campus, with additional numbers of employers advising of career potential by mail or phone.

Career Planning and Placement Center personnel provide individual and group career advisory programs on job and graduate school opportunities and placement in general. Other functions of the center include helping students find summer work and temporary or part-time jobs related to their field of study, and assisting alumni with career adjustments.

In addition to its responsibilities to students the center also serves as a connecting link between the University and the business and industrial community with the further responsibility of keeping the faculty and administration informed of employment trends.

HEALTH

North Carolina State University seeks to safeguard the health of the student in every way possible. The University maintains a 76-bed infirmary which is open 24 hours a day. The infirmary is fully staffed by physicians, nurses and auxiliary personnel. Among the many valuable features of the infirmary are an up-to-date first-aid department and x-ray department.

The University physicians observe regular daily office hours at the infirmary in the mornings and afternoons. In addition, they visit the



infirmary more often when necessary. A graduate nurse is on duty day and night. Students have free access to the infirmary at all times.

In case of accident or the serious illness of a student, parents or guardians will be notified immediately. No surgical operation will be performed without full consent of parents or guardians, except in cases of extreme emergency.

The medical fee paid by each student provides for infirmary service, general medical treatment and the services of nurses. It does not provide for surgical operations, outside hospital care, or the services of dentists or other specialists.

Before the student enters North Carolina State University, he should have a complete, thorough examination by his family physician. Any abnormality should be noted and all defects corrected in order to prevent unnecessary loss of time while the student is in college. If the examination is not made before he enters, the student will be given a physical examination at the University, for which a fee is charged. Blanks for the physical examination may be secured from the Office of Admissions.

ACCIDENT AND HEALTH INSURANCE

The University offers annually a plan of student accident and health insurance. The insurance is planned to cover the surgical, accident and hospital needs of the student, as a supplement to the services offered through the infirmary. Each year complete information will be made available to students before the opening of school.

Foreign students are required to enroll in the sickness and accident insurance plan provided through the University or to have similar coverage under other insurance plans or arrangements with their sponsors.

ORIENTATION

The University sponsors a Summer Orientation Program for all new students. Anyone who, because of extreme hardship, finds that he is unable to attend the summer program may request permission to attend late orientation during the week preceeding the opening of school.

The orientation program is designed to acquaint new students with the academic, extracurricular and social life at North Carolina State University. A planned series of meetings and conferences with faculty and student leaders gives newcomers to the campus the information needed to get their college careers underway.

COUNSELING

The Counseling Center in Peele Hall has a staff of counselors to help students with the problems of adjustment to college life, problems of vocational and curricular choice and any other problems a student might wish to discuss. The center administers aptitude and interest tests and maintains a file of occupational information to help guide students in career selection.

Referral can be made for students needing special kinds of help, including psychiatric service and marriage counseling.

Students may come to the center on their own accord, or they may be referred by teachers, advisers or other members of the University staff. There is no charge for conferences, but a small materials fee is charged when tests are administered.

FACULTY ADVISERS

When a student enrolls at State, he is assigned to a faculty adviser who is usually a member of the department in which he will be taking his major work. The adviser (a) provides information, advice and recommendations in academic and related areas, (b) directs the student to sources which explain in detail academic regulations, course prerequisites and graduation requirements, (c) helps the new student to understand the degree to which he should assume responsibility for his own program planning, (d) provides vocational guidance and occupational information in his area of specialty, and (e) refers the student to the appropriate individual, office or agency when further assistance is indicated. Deans, directors of instruction and department heads are also available to students wanting information about different curricula and help in forming educational plans. Instructors are usually the best source of help to students having difficulty with particular subjects. Members of the faculty keep office hours and expect students to consult them individually whenever special assistance is needed.

COOPERATING RALEIGH COLLEGES

The Cooperating Raleigh Colleges is a voluntary organization comprised of North Carolina State University, Meredith College, Peace College, St. Augustine's College, St. Mary's Junior College and Shaw University for the purpose of developing and conducting cooperative educational activities. The organization provides the opportunity for any student to enroll at another institution for a course or courses not offered on his home campus. Other activities include a cooperative library arrangement, joint student activities, and faculty cooperation and interchange.



Student Activities

North Carolina State University makes every effort to provide the student with surroundings which are pleasant and conducive to intellectual growth. Respecting the student as an individual, the University assures him the maximum of personal liberty within the limits necessary for orderly progression of class work. In return, he is expected to pay serious attention to his purpose in attending this University and to observe rules of conduct consistent with maturity. Through the various services and activities identified with everyday life on campus, as well as through the several extracurricular organizations and functions, the student at State has an excellent opportunity for acquiring experience in group leadership and community living which may serve him well in his professional career.

As the student progresses in his development, he will find many opportunities to increase his growth in citizenship by participating in the activities of his academic class and of the student body in general. Following is a survey of the various activities at North Carolina State University.

STUDENT BODY GOVERNMENT AND THE STUDENT BODY CODE

When a student enters North Carolina State University, he becomes a member of a self-governing community. Legislative, executive and judicial authority, insofar as student affairs are concerned, rest with the Student Body Government which operates within the framework of over-all University administration. The Student Body Government members and judicial department members are elected in campus-wide elections. The student has a voice in his own government by participating in these elections. Often in general elections he is asked to vote on proposed changes in policies which affect the student body.

The Student Body Code prescribes that University students must not lie, cheat or steal, nor exhibit behavior which does not reflect the standards of the Student Body.

CLUBS AND SOCIETIES

Through the various honorary, professional, technical and social organizations at North Carolina State University, the interested student finds many opportunities to participate in activities that appeal to him, and to meet others who have similar interests.

HONORARY

Honorary societies at North Carolina State University are Golden Chain, senior leadership; Blue Key, junior leadership; Thirty and Three, sophomore leadership; Phi Eta Sigma, men's freshman scholarship; Alpha Lambda Delta, women's freshman scholarship; and Phi Kappa Phi, junior, senior and graduate students scholarship.

PROFESSIONAL AND TECHNICAL

Each school at North Carolina State University sponsors or supervises a large number of professional and technical societies and clubs. Students in every area of instruction are encouraged to join with their fellow students in pursuing their common interests. Many of these organizations contribute greatly to the student's professional and social growth.

SOCIAL FRATERNITIES AND SORORITIES

Seventeen national social fraternities have chapters at State. The University recognizes that the Interfraternity Council is the student organization responsible for fraternity matters and programs. Each chapter has two IFC Representatives. The objectives of the Interfraternity Council are to promote the general interests and welfare of the associated fraternities and to insure cooperation among the fraternities, the faculty, the student body and the general public. A significant number of student leaders are members of the fraternity system. All fraternities have resident housemothers who act as hostesses and assist in planning meals and social functions.

The social fraternities at North Carolina State are Alpha Gamma Rho, Delta Sigma Phi, FarmHouse, Kappa Alpha, Kappa Sigma, Lambda Chi Alpha, Phi Kappa Tau, Pi Kappa Alpha, Pi Kappa Phi, Sigma Alpha Epsilon, Sigma Alpha Mu, Sigma Chi, Sigma Nu, Sigma Phi Epsilon, Sigma Pi, Tau Kappa Epsilon and Theta Chi.

State also has two national social sororities, Sigma Kappa and Alpha Delta Pi.

STUDENT PUBLICATIONS

A variety of publications, both general and school-sponsored, are edited and managed by student officers, with faculty members serving as advisers. A student may gain journalistic experience and training in writing, editing or management by working on these publications.

The three general publications, *The Agromeck*, the student broadcasting system, WPAK/WKNC-FM, and *The Technician*, are supported in large part by a publication fee included in each student's fees.

The Agromeck is the University yearbook, providing a record of the senior class and of the principal events of the school year. The yearbook recalls in pictures the varied activities of the student body throughout the year, and is published for the entire student body.

The Technician is the student newspaper issued three mornings a week and delivered to central locations on the campus, such as the coliseum, cafeterias, classroom buildings and the Student Supply Store. *The Technician* serves as a forum for student expression as well as a medium for campus news of particular interest to State students.

Although it is not a publication in the strictest sense of the word, WPAK/WKNC-FM (at 600 KC), serves the same function through a different medium. It offers many opportunities for extracurricular training in actual broadcasting techniques as well as training in administration and program planning. The station transmits on carrier current and educational FM.



In the School of Design individual creative expression is emphasized, but teamwork is also encouraged.

Each student receives a copy of *The North Carolina State Record (The Tower)*, a University handbook, which contains detailed information about student organizations, activities and policies.

Several of the schools have their own publications issued under the general supervision of the particular school and dealing with material of special interest to students in that school. These publications include *Agri-Life* published by the School of Agriculture and Life Sciences; *The Pi-Ne-Tum*, published by the School of Forest Resources; *The Southern Engineer*, published by the School of Engineering; *The Textile Forum*, published by the School of Textiles; *The Publications of the School of Design*; and *The Scientist*, published by the School of Physical and Mathematical Sciences.



ATHLETICS

In addition to voluntary programs of intramural and intercollegiate sports, State requires freshmen and sophomores to enroll in credit courses in physical education. Juniors and seniors may take physical education as an elective.

Intramural—The University maintains an extensive program of intramural sports, administered by the Department of Physical Education. Participation in these sports is purely voluntary and college credit is not given. Competition is divided into three divisions: residence halls, fraternity and open. Twelve sports are offered in the residence halls and fraternity divisions, and 10 sports plus special events in the open division.

Sports offered in the intramural program are correlated with those taught in the required programs of physical education. Instruction in these sports is given in the classes and opportunity for competition is provided in the intramural program. An intramural Advisory Board, composed of student representatives and one physical education staff member, determines the policies to be administered by the intramural director.

The intramural facilities, both indoor and outdoor, are excellent. The intramural playing fields, adjacent to the gymnasium, provide space for 10 softball or 10 football games to be played simultaneously. Twenty-six tennis courts are available.

The gymnasium has 10 four-wall handball courts, six squash courts and separate rooms for boxing, wrestling, golf, correctives and weightlifting. The main gymnasium floor provides seven basketball courts which may be adjusted to accommodate four volleyball courts, 12 badminton courts, indoor tennis and various other sports. This space also includes a gymnastic area greater than the size of a regulation basketball court.

The swimming pool, located in an adjoining building, is 25 meters by 25 yards and has two one-meter and one three-meter diving boards.

Intercollegiate—Intercollegiate athletics at North Carolina State University come under the supervision of a separate department of the institution. Policies governing intercollegiate competition are recommended, however, by the Athletics Council which is composed of faculty, students and alumni. The policies are in full accord with the Atlantic Coast Conference and N.C.A.A. rules of eligibility for intercollegiate contests. Membership of the Atlantic Coast Conference includes—in addition to North Carolina State University—Duke University, Wake Forest University, the University of North Carolina at Chapel Hill, the University of Maryland, Clemson University, the University of South Carolina and the University of Virginia.

The program in intercollegiate athletics consists of the organization and training of "Wolfpack" teams in football, basketball, baseball, track, cross country, wrestling, swimming, tennis, golf, soccer, fencing and rifle competition.

Facilities for intercollegiate athletics at State include Carter Stadium a 41,000-seat stadium for football; William Neal Reynolds Coliseum, a 12,500-seat arena for basketball; football practice fields; tennis courts; a swimming pool of olympic dimensions; a gymnasium; a baseball field and facilities in the Coliseum for wrestling and other sports.

MUSICAL ORGANIZATIONS

Since the early days of North Carolina State, musical organizations have played an important part in the life of the campus. These groups present concerts, furnish music for official university functions, and perform at athletic events. The combined membership of these organizations constitutes the largest voluntary student organization on campus. Students may join the bands, choral groups and orchestras by reporting for an audition at the time and location indicated in the Orientation schedule. Rehearsals are carefully arranged to avoid conflicts with study time or other classes.

Bands—The Symphonic Band, the Fanfare Band, the Brasschoir Band and the Marching Band make up the four divisions of the N. C. State Bands. Each band serves a specific purpose in the musical life of the campus. Assignments to the various bands are made according to the interests and abilities of the individual students. The Symphonic, Fanfare, and Brasschoir Bands are concert organizations, with the Symphonic Band having the most rigid requirements. The Marching Band, finest in the Atlantic Coast Conference, operates primarily during football season and is widely known for its spectacular half-time performances. The Clarinet Choir is an organization of E \flat , B \flat , Alto, Bass and Contrabass Clarinets. It is open to all regularly enrolled students.

Choral Groups—The two divisions of the North Carolina State choral program are the Varsity Men's Glee Club and the N. C. State Choir. Placement in these organizations is made according to abilities and interests of the individual. The Varsity Men's Glee Club is by history and tradition the prime performing group on campus and maintains a high level of entrance requirements. The N. C. State Choir also requires a high level of musical interests and abilities. The choir is so constituted that on occasion the male section performs as the Collegiate Men's Glee Club and the female section is utilized as the Women's Chorus. The Varsity and the Choir present several concerts each year, both on and off the campus. Radio and television appearances, recordings, tours and the providing of small ensembles for special occasions are additional activities. For those interested in additional study of singing techniques, a Voice Class is offered.

Orchestras—Through a wide range of orchestral music, read and performed, suitable aesthetic needs of those actively involved in the orchestral offerings are met. Placement in the North Carolina State University Symphony Orchestra is according to the interest and ability of each individual. A position in the North Carolina State University Chamber Orchestra is dependent upon placement in the Symphony Orchestra. Both orchestras present several concerts each year on and off campus. An opportunity to coordinate musical efforts with professional musicians, recognized locally and nationally, is an integral part of these concerts. Provisions are made for those with an interest in string quartet and other small ensemble experience.

NCS Pipes and Drums—The newest musical organization on the North Carolina State campus is a Highland bagpipe group. One purpose of this organization is to provide an opportunity for interested students to learn an instrument known to many of North Carolina's early settlers.

Another purpose is for this group to represent the university through a unique and distinctive medium. Pipes and drums are provided. The organization performs at many university and community functions. No piping experience is necessary. Membership is open to all regularly enrolled students. Students interested in more details should contact the Music Department.

Musician-in-Residence—North Carolina State University established this special chair in the Department of Music to help facilitate the cultural development of the entire University. Internationally known performers are appointed to the Musician-in-Residence position on a rotating basis. The person holding this appointment performs a wide range of functions including concerts and programs, both formal and informal, presented throughout the year for the benefit and enjoyment of all students, as well as providing his talents and imparting his knowledge to various schools and departments as requested. Information concerning this unique program may be had by contacting the Director of Music.

STUDENT CENTERS

Two important centers for the extracurricular activities of State students are the Erdahl-Cloyd Union and the E. S. King Religious Center.

Erdahl-Cloyd Union—The Erdahl-Cloyd Union building is not only the center for an extensive social and cultural program, but also provides facilities for recreation and relaxation. In addition to a snack bar, dining room, barber shop and ballroom, there are meeting rooms, lounge areas, a gallery for exhibits, guest rooms and a games room. The offices of the Student Government and other organizations are located on the second floor. The Union operates a theatre and craft shop in the Frank Thompson building.

The purpose of the Union is to provide a facility and, through the Student Government Services Boards, a program which will complement the academic life of the student and offer him an opportunity to further already existing interests and to develop new ones. Most of the programs are planned and carried out by students. Everyone is encouraged to participate in some aspect of these activities.

A new University Center is scheduled to open in the fall of 1971. It will include facilities now housed in the Erdahl-Cloyd Union.

King Religious Center—In addition to the functions and activities held in the Erdahl-Cloyd Union, many other activities—especially those of a religious, spiritual and devotional nature—are held within the E. S. King Religious Center. The center has an attractive lobby equipped with writing and reading tables and chairs, a television room and conference rooms where students and faculty groups may meet. The coordinator of religious affairs and several denominational chaplains have their offices in this building. Temporary quarters in the building are being used by the Music Department, WKNC—the FM student radio station, the Agromeck, the Technician and the Black Student Union.

The Danforth Chapel, located in the center, provides a place for religious services and meditation for students of all faiths.

The E. S. King Religious Center plans social events and lectures on various topics related to student life in addition to, or in connection with, its programs of religious emphasis.

University Calendar*

SPRING SEMESTER 1971*

January 4	Monday	New student orientation begins.
January 4-5	Monday-Tuesday	All students complete registration.
January 6	Wednesday	Change day (late registration, drops and adds).
January 7	Thursday	First day of classes.
January 14	Thursday	Last day to add a course.
January 21	Thursday	Last day to withdraw (or drop a course) with refund; last day to drop a course without a grade.
March 4	Thursday	Midsemester reports of academic difficulty due; spring vacation begins at 10:00 p.m.
March 15	Monday	Classes resume at 8:00 a.m.
April 12	Monday	Holiday.
April 29	Thursday	Last day of classes.
April 30-May 1	Friday-Saturday	Reading days.
May 3-12	Monday-Saturday	Final examinations.
	Monday-Wednesday	
May 15	Saturday	Commencement.

SUMMER 1971*

First Session

May 31-June 2	Monday-Wednesday	Opening days; residence halls open; counseling, advising, etc.
June 3	Thursday	New student orientation; registration and payment of fees; late registration fee for those who complete registration after 12:00 noon, June 3.
June 4	Friday	First day of classes.
June 5	Saturday	Regular class day.
June 8	Tuesday	Last day to register; last day to withdraw (or drop a course) with refund; last day to drop a course without a grade.
June 12	Saturday	Regular class day.
July 5	Monday	Holiday.
July 7	Wednesday	Last day of classes.
July 8	Thursday	Final examinations.

* Tentative, subject to approval of the Board of Trustees.

Second Session

July 9	Friday	Opening day; residence halls open; counseling, advising, etc.
July 12	Monday	New student orientation; registration and payment of fees; late registration fee for those who complete registration after 12:00 noon, July 12.
July 13	Tuesday	First day of classes.
July 16	Friday	Last day to register; last day to withdraw (or drop a course) with refund; last day to drop a course without a grade.
July 17	Saturday	Regular class day.
July 24	Saturday	Regular class day.
August 12	Thursday	Last day of classes.
August 13	Friday	Final examinations.

FALL SEMESTER 1971*

August 18-20	Wednesday-Friday	Opening days; residence halls open; counseling, advising, etc.
August 22-24	Sunday-Tuesday	Late orientation (for new students who did not attend Summer Orientation Program).
August 23	Monday	General faculty meeting.
August 23-24	Monday-Tuesday	All students complete registration.
August 25	Wednesday	Change day (late registration, drops and adds).
August 26	Thursday	First day of classes.
September 2	Thursday	Last day to add a course.
September 6	Monday	Holiday.
September 9	Thursday	Last day to withdraw (or drop a course) with refund; last day to drop a course without a grade.
October 15	Friday	Midsemester reports of academic difficulty due.
November 23	Tuesday	Thanksgiving holidays begin at 10:00 p.m.
November 29	Monday	Classes resume at 8:00 a.m.
December 10	Friday	Last day of classes.
December 11	Saturday	Reading day.
December 13-20	Monday-Monday	Final examinations.

* Tentative, subject to approval of the Board of Trustees.

SPRING SEMESTER 1972*

January 3	Monday	Opening day; residence halls open; counseling, advising, etc.
January 3	Monday	New student orientation begins.
January 3-4	Monday-Tuesday	All students complete registration.
January 5	Wednesday	Change day (late registration drops and adds).
January 6	Thursday	First day of classes.
January 13	Thursday	Last day to add a course.
January 20	Thursday	Last day to withdraw (or drop a course) with refund; last day to drop a course without a grade.
March 2	Thursday	Midsemester reports of academic difficulty due; spring vacation begins at 10:00 p.m.
March 13	Monday	Classes resume at 8:00 a.m.
April 3	Monday	Holiday.
April 27	Thursday	Last day of classes.
April 28-29	Friday-Saturday	Reading days.
May 1-10	Monday-Saturday	Final examinations.
	Monday-Wednesday	
May 13	Saturday	Commencement.

SUMMER 1972*

First Session

May 29-31	Monday-Wednesday	Opening days; residence halls open; counseling, advising, etc.
June 1	Thursday	New student orientation; registration and payment of fees; late registration fee for those who complete registration after 12:00 noon, June 1.
June 2	Friday	First day of classes.
June 3	Saturday	Regular class day.
June 6	Tuesday	Last day to register; last day to withdraw (or drop a course) with refund; last day to drop a course without a grade.
June 10	Saturday	Regular class day.
July 4	Tuesday	Last day of classes.
July 5	Wednesday	Final examinations.

* Tentative, subject to approval of the Board of Trustees.

Second Session

July 6-7	Thursday-Friday	Opening days; residence halls open; counseling, advising, etc.
July 10	Monday	New student orientation; registration and payment of fees; late registration fee for those who complete registration after 12:00 noon, July 10.
July 11	Tuesday	First day of classes.
July 14	Friday	Last day to register; last day to withdraw (or drop a course) with refund; last day to drop a course without a grade.
July 15	Saturday	Regular class day.
July 22	Saturday	Regular class day.
August 10	Thursday	Last day of classes.
August 11	Friday	Final examinations.

FALL SEMESTER 1972*

August 16-18	Wednesday-Friday	Opening days; residence halls open; counseling, advising, etc.
August 20-22	Sunday-Tuesday	Late orientation (for new students who did not attend Summer Orientation Program).
August 21	Monday	General faculty meeting.
August 21-22	Monday-Tuesday	All students complete registration.
August 23	Wednesday	Change day (late registration, drops and adds).
August 24	Thursday	First day of classes.
August 31	Thursday	Last day to add a course.
September 4	Monday	Holiday.
September 7	Thursday	Last day to withdraw (or drop a course) with refund; last day to drop a course without a grade.
October 13	Friday	Midsemester reports of academic difficulty due.
November 21	Tuesday	Thanksgiving holidays begin at 10:00 p.m.
November 27	Monday	Classes resume at 8:00 a.m.
December 8	Friday	Last day of classes.
December 9	Saturday	Reading day.
December 11-18	Monday-Monday	Final examinations.

* Tentative, subject to approval of the Board of Trustees.



The Students Supply Stores is the center for purchasing books and other school supplies as well as personal items.

SCHOOLS AND PROGRAMS OF STUDY

There are eight major undergraduate academic divisions at North Carolina State University. These are the Schools of Agriculture and Life Sciences, Design, Education, Engineering, Forest Resources, Liberal Arts, Physical and Mathematical Sciences, and Textiles. The programs of study are outlined by school. Information concerning specific courses is given in the section of the catalog on course descriptions.

In addition to information on the schools, this section contains descriptions of the military training program (ROTC), the Graduate School, Continuing Education and Summer Sessions.

Throughout the programs of study given in this section, departmental codes, course numbers and course titles are used. The key to the departmental code is listed below. This key will also aid in locating individual course descriptions.

CODE	NAME	MAT	Materials Engineering
AC & ALS	Agriculture and Life Sciences (General Courses)	MB	Microbiology
ANS	Animal Science	MLE	English (Foreign Students)
ANT	Anthropology	MLF	French
ARC	Architecture	MLG	German
ART	Art	MLI	Italian
AS	Aerospace Studies (ROTC)	MLR	Russian
BAE	Biological and Agricultural Engineering	MLS	Spanish
BCH	Biochemistry	MS	Military Science (ROTC)
BMA	Biomathematics	MUS	Music
BO	Botany	MY	Meteorology
BS	Biological Sciences	NE	Nuclear Engineering
CE	Civil Engineering	NTR	Nutrition
CH	Chemistry	OR	Operations Research
CHE	Chemical Engineering	OY	Physical Oceanography
CS	Crop Science	PD	Product Design
CSC	Computer Science	PE	Physical Education
DN	Design	PHI	Philosophy
E	Engineering (General Courses)	PHY	Physiology
EC	Economics	PO	Poultry Science
ED	Education (General Courses)*	PP	Plant Pathology
EE	Electrical Engineering	PS	Politics
EH	Engineering Honors	PSM	Physical and Mathematical Sciences (General Courses)
EM	Engineering Mechanics	PSY	Psychology
ENG	English	PY	Physics
ENT	Entomology	REL	Religion
EO	Engineering Operations	RRA	Recreation Resources Administration
FOR	Forest Resources**	SOC	Sociology
FS	Food Science	SP	Speech
GN	Genetics	SS	Social Studies
GY	Geology	SSC	Soil Science
HI	History	ST	Statistics
HS	Horticultural Science	T	Textiles (General Courses)
IA	Industrial Arts	TC	Textile Chemistry
IE	Industrial Engineering	TOX	Toxicology
ISO	International Student Orientation	TX	Textile Technology
LAR	Landscape Architecture	UD	Urban Design
MA	Mathematics	UNI	University Studies
MAE	Mechanical and Aerospace Engineering	WPS	Wood and Paper Science and Technology
MAS	Marine Sciences	ZO	Zoology

* This includes Adult and Community College Education, Agricultural Education, Guidance and Personnel Services, Industrial and Technical Education, and Mathematics and Science Education.

** This includes Conservation and Forestry.

AGRICULTURE AND LIFE SCIENCES

Patterson Hall

E. W. GLAZENER, *Acting Dean and Director of Academic Affairs*

Modern agriculture is a complex industry built on the principles of science and business. The basic sciences, particularly the biological sciences, are the foundations for modern agricultural technology. These sciences applied to understanding the functions of living material, offer a background as preparation for a professional agriculturist or as a preparatory program for the medical sciences. Likewise, the behavioral sciences, especially economics and sociology, provide preparation for the business and managerial aspects of agricultural enterprises.

The objectives of the academic program for the students in The School of Agriculture and Life Sciences are as follows:

- (1) To provide an opportunity for a broad university education.
- (2) To offer a variety of learning experiences in an effort to stimulate individualized and continued learning.
- (3) To offer a choice of specialization sufficient for initial employment.

A high percentage of all the gainfully employed persons in the United States are engaged in operations directly or indirectly related to agriculture. For example, the food industry ranges from those who produce the food, supply material to the producer and process the finished product, to those who sell the products to the consumer. Hundreds of distinct occupations are represented in modern agriculture and biology. The demand for graduates is many times greater than the supply. Experts are predicting an increased shortage of graduates of programs offered in this school.

FACILITIES

North Carolina State University is fortunate to have at its disposal the newest equipment and facilities in many fields. Laboratories are well equipped with modern equipment, such as an electron microscope, and with the necessary materials for learning and practicing the basic and applied sciences. Machinery and equipment, in some cases provided by private industry, keep students abreast of the latest technological advances. Extensive plant, animal and insect collections are available for teaching and research.

The D. H. Hill Library at North Carolina State University has a large collection of scientific books and periodicals which provide excellent source material for many courses. In addition, students may draw from the specialized periodicals and textbooks in the departmental libraries.

Research farms of the University provide a practical classroom for many courses as well as a place where researchers can carry on basic and applied research.

STUDENT ACTIVITIES

Students in the School of Agriculture and Life Sciences have ample opportunities to take part in many broadening extracurricular activities. Most departments have student organizations which provide professional as well as social experience. Representatives of these clubs form the Agri-Life Council. This council is the student organization representing the school. Student tours provide an opportunity to see firsthand the application of classroom principles.

In addition, students representing agronomy, animal science, horticultural science, food science, poultry science and soil science compete regionally and nationally, in a number of activities providing student members a chance to learn by travel as well as by participation.

CURRICULA OFFERINGS AND REQUIREMENTS

A freshman enrolling in agriculture and life sciences has a common core of courses the first year, courses that are appropriate in all curricula. This method allows the student time to study various programs before selecting a curricula in science (agricultural or biological), business or technology. In addition to the basic courses in English, biology, and physical and social sciences, the student selects a major in a department. A number of choices are provided in the areas of animal science, plant science, soils, food science, engineering, economics and sociology.

Departmental and interdepartmental majors offered in the curricula are as follows:

Science—agricultural economics, biological and agricultural engineering (joint program with the School of Engineering), animal science, botany, crop science, conservation, food science, entomology, horticultural science, medical technology, plant protection, poultry science, rural sociology, soil science, wildlife biology and zoology. Premedical sciences are offered in this curriculum.

Biological Sciences—an interdepartmental broad spectrum curriculum with emphasis on biological and physical sciences, especially designed for graduate or professional courses requiring a biology background.

Business—emphasis on economics, combination programs in technology in animal science, crop science, horticultural science, poultry science and soil science.

Technology—biological and agricultural engineering, animal science, agronomy, food science, horticultural science and poultry science.

HONORS PROGRAMS

The School of Agriculture and Life Sciences has a comprehensive Honors Program for qualified freshmen and sophomores interested in participating in seminar discussion programs on broad topics. These sessions are led by outstanding professors.

Qualified juniors and seniors have an opportunity to participate in an independent research program. Faculty direction is provided on an individual basis to each student. The student has the opportunity to select his project.

DEGREES

The Bachelor of Science degree is conferred upon the satisfactory completion of one of the curricula in this School.

The degrees of Master of Science, Master of Agriculture and professional degrees are offered in the various departments of agriculture and life sciences after the satisfactory completion of at least one year of graduate study in residence.

The Doctor of Philosophy degree is offered by the following departments: economics, biological and agricultural engineering, animal science, biochemistry, crop science, botany, microbiology, entomology, food science, genetics, plant pathology, sociology and anthropology, soil science and zoology.

Further information on graduate offerings may be found in the Graduate School Catalog.

OPPORTUNITIES

Broad and fascinating opportunities in business, industry, education and government are open to graduates of agriculture and life sciences. Some of the areas in which graduates are employed are as follows:

Business and Industry—banking and credit, insurance, farm management, cooperatives, land appraisal, marketing, transportation, food chains, food packing, machinery and equipment, chemicals, fertilizer, feed manufacturing, seed processing.

Communications—writing, reporting, radio, television, newspapers, magazines, advertising, publications.

Conservation—soil, water, range, forest, fish, wildlife parks, recreation.

Education—high school and college instruction in agriculture or biology, agricultural extension, governmental, and industrial agencies.

Farming and Ranching—general, livestock, field crops, fruits, vegetables, poultry, ornamentals.

Preprofessional and Graduate Preparation—premedical programs for training for medical, dental and veterinary colleges, graduate programs.

Research—production, marketing, engineering, processing, conservation, organizational structure, group behavior.

Services—inspection and regulation, production field service, quality control and grading, agricultural technology and consulting.

A placement office as a part of the University Placement Center is maintained to assist graduates in career development and placement.

INTERNATIONAL ASPECTS

An International Seminar is offered to those students who are interested. In addition, an International Option, requiring modern language and 12 semester hours of appropriate courses in the social sciences, is available for interested students enrolled in any curricula.

FRESHMAN YEAR

The curricula in the School of Agriculture and Life Sciences have a common freshman year with the exception of the science program in biological and agricultural engineering. For the agricultural science, biological and agricultural engineering freshman year, see freshman year in school of engineering.

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ALS 103 Orientation	1	ENG 112 Composition and Reading	3
BS 100 General Biology	4	MA 112 Analytic Geometry and Calculus A ..	4
or		or	
CH 101 General Chemistry I	4	MA 114 Topics in Modern Math	3
ENG 111 Composition and Rhetoric	3	PS 201 The American Governmental	
HI 105 Modern Western World	3	System	3
MA 111 Algebra and Trigonometry*	4	Elective	4
Physical Education	1	Physical Education	1
(Military Science or Air Science may		(Military Science or Air Science may	
be elected)		be elected)	
	16		14-15

* Does not contribute to the 130 semester hours required in the Biological Sciences curriculum.

CURRICULA IN AGRICULTURE AND LIFE SCIENCES*

Science, business and technology are three curricula offered in this school. All departments offer the science curriculum. In addition an interdepartmental curriculum in biological sciences is offered see pages 82-85. Several departments offer the choice of either science or technology. A business curriculum is offered in agricultural economics or in combination with the completion of both the technology and business curricula in animal science, crop science, horticultural science, poultry science and soil science. Courses peculiar to a specific department are listed under the departmental requirements.

All of the curricula have a core of required courses on a school basis. Listed below are these requirements:

SCIENCE

	Credits		
ALS 103 Orientation	1	CH 103 General Chemistry II	4
<i>Languages (12 Credits)</i>		or	
ENG 111 Composition and Rhetoric	3	CH 107 Principles of Chemistry	4
ENG 112 Composition and Reading	3	MA 111 Algebra and Trigonometry	4
Electives (English or Modern Language) ..	6	MA 112 Analytic Geometry and Calculus A ..	4
<i>Social Sciences and Humanities</i>		or	
<i>(21 Credits)</i>		MA 114 Topics in Modern Math	3
Electives from Group D	21	PY 221 College Physics	5
<i>Physical and Biological Sciences</i>		or	
<i>(28-32 Credits)</i>		PY 211, 212 General Physics	8
BS 100 General Biology	4	<i>Electives (60-64 Credits)</i>	
Biological Sciences Elective	4	Restricted Electives from Group A	22-26
CH 101 General Chemistry I	4	Departmental Requirements and Electives ..	26
		Free Electives	12
		Subtotal	126
		Physical Education	4
		Total Hours—130**	

BUSINESS

	Credits		
<i>Accounting:</i>		<i>Finance:</i>	
EC 312 Accounting I	3	EC 402 Financial Institutions	3
EC 313 Accounting II	3	EC 415 Farm Appraisal and Finance	3
EC 409 Introduction to Production	3	EC 420 Corporation Finance	3
Costs	3	<i>Personnel:</i>	
EC 414 Tax Accounting	3	EC 426 Personnel Management	3
<i>Production:</i>		EC 431 Labor Economics	3
EC 303 Farm Management	3	EC 432 Industrial Relations	3
EC 425 Industrial Management	3	<i>Business Management:</i>	
EC 551 Agricultural Production	3	EC 310 Economics of the Firm	3
Economics	3	EC 525 Management Policy and Decision ..	3
<i>Marketing:</i>		Making	3
EC 311 Agricultural Markets	3	<i>Electives:</i>	
EC 411 Marketing Methods	3	EC 301 Production and Prices	3
EC 521 Markets and Trade	3	EC 302 National Income and	3
		Economic Welfare	3
		Group B Courses	

Students in the business curriculum complete a minimum of 24 semester hours of Group B courses. One course is required in the areas of accounting, production, marketing, finance, personnel and management. In addition, two courses are elected from the Group B course offerings.

TECHNOLOGY

Credits

ALS 103 Orientation	1
<i>Languages (12 Credits)</i>	
ENG 111 Composition and Rhetoric	3
ENG 112 Composition and Reading	3
SP 231 Expository Speaking	3
Elective (English or Modern Language)	3

Social Sciences and Humanities (21 Credits)

EC 205 Economic Activity	3
EC 212 Economics of Agriculture	3
HI 105 Modern Western World	3
PS 201 The American Governmental System	3
SOC 202 Principles of Sociology	3
Electives from Group D	6

Physical and Biological Sciences (32-33 Credits)

BS 100 General Biology	4
Biological Sciences Elective	4
CH 101 General Chemistry I	4

CH 103 General Chemistry II	4
or	
CH 107 Principles of Chemistry	4
MA 111 Algebra and Trigonometry	4
MA 112 Analytic Geometry and Calculus A	4
or	

MA 114 Topics in Modern Math	3
PY 221 College Physics	5
SSC 200 Soils	4

Electives (59-60 Credits)

Restricted Electives from Groups A, B or C	20-21
Departmental Requirements and Electives	27
Free Electives	12

Subtotal	126
Physical Education	4

Total Hours—130**

* Group A includes the physical and biological sciences; Group B, economics and business management; Group C, applied science and technology; Group D, social sciences and humanities.
** All curricula require the completion of one course in literature.

ELECTIVES

GROUP A

PHYSICAL SCIENCES:

Biochemistry:

BCH 351	Elementary Biochemistry
BCH 452	Experimental Biochemistry

Chemistry:

CH 107	Principles of Chemistry
CH 220	Introductory Organic Chemistry
CH 221	Organic Chemistry I
CH 223	Organic Chemistry II
CH 315	Quantitative Analysis
CH 331	Introductory Physical Chemistry

Computer Science:

CSC 111	Algorithmic Languages I
CSC 112	Basic Computer Organization and Assembly Language
CSC 211	Programming Languages

Geosciences:

GY 120	Physical Geology
GY 208	Physical Geography
	Meteorology
GY 486	Weather and Climate

Mathematics:

Must use one or the other of the following two sequences: MA 111, 112, 212, or MA 102, 201, 202
MA 102 Analytical Geometry and Calculus I

MA 111	Algebra and Trigonometry
MA 112	Analytical Geometry and Calculus A
MA 114	Topics in Modern Math
MA 201	Analytical Geometry and Calculus II
MA 202	Analytical Geometry and Calculus III
MA 212	Analytical Geometry and Calculus B
MA 301	Applied Differential Equations I

Meteorology:

MY 411	Introductory Meteorology
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Physics:

PY 223	Astronomy and Astrophysics
PY 407	Introduction to Modern Physics

Soil Science:

SSC 200	Soils
SSC 511	Soil Physics
SSC 520	Soil and Plant Analysis
SSC 522	Soil Chemistry

Statistics:

ST 311	Introduction to Statistics
ST 361	Introduction to Statistics for Engineers I

BIOLOGICAL SCIENCES:

Animal Science:

ANS 301 (FS 301, NTR 301)	Nutrition and Man
ANS 401	Reproductive Physiology
ANS 405	Lactation

ANS 415 (NTR 415, PO 415)	Comparative Nutrition
ANS 502 (PHY 502)	Reproductive Physiology of Vertebrates

Biological and Agricultural Engineering:

BAE 303 Energy Conversion for
Agricultural Production

Botany:

BO 200 Plant Life
BO 360 (ZO 360) Introduction to Ecology
BO 403 Systematic Botany
BO 414 (ZO 414) Cell Biology
BO 421 Plant Physiology

Entomology:

ENT 301 Introduction to Forest Insects
ENT 312 Introduction to Economic
Insects
ENT 502 Insect Diversity
ENT 503 Functional Systems of Insects
ENT 550 Fundamentals of Insect
Control
ENT 562 Agricultural Entomology
ENT 582 (ZO 582) Medical and Veterinary
Entomology

Food Science:

FS 402 Food Chemistry
FS 405 (MB 405) Food Microbiology
FS 506 (MB 506) Advanced Food
Microbiology

Genetics:

GN 504 Human Genetics
GN 532 (ZO 532) Biological Effects of
Radiations
GN 540 (ZO 540) Evolution

Microbiology:

MB 401 General Microbiology
MB 405 (FS 405) Food Microbiology
MB 506 (FS 506) Advanced Food
Microbiology
MB 514 Microbial Metabolism
MB 571 Virology

Plant Pathology:

PP 315 Plant Diseases
PP 318 (FOR 318) Forest Pathology
PP 500 Plant Disease Control

Poultry Science:

PO 401 Poultry Diseases
PO 415 (ANS 415, NTR 415) Comparative
Nutrition
PO 524 (ZO 524) Comparative
Endocrinology

Zoology:

ZO 201 Animal Life
ZO 223 Comparative Anatomy
ZO 315 General Parasitology
ZO 345 Histology
ZO 350 Invertebrate Zoology
ZO 351 Vertebrate Zoology
ZO 360 (BO 360) Introduction to Ecology
ZO 361 Vertebrate Embryology
ZO 414 (BO 414) Cell Biology
ZO 420 Fishery Science
ZO 421 Vertebrate Physiology
ZO 441 Ichthyology
ZO 524 (PO 524) Comparative Endocrinology
ZO 540 (GN 540) Evolution

GROUP B**ECONOMICS AND BUSINESS MANAGEMENT:****Economics:**

EC 301 Production and Prices
EC 302 National Income and
Economic Welfare
EC 303 Farm Management
EC 310 Economics of the Firm
EC 311 Agricultural Markets
EC 312 Accounting I
EC 313 Accounting II
EC 317 Introduction to Methods of
Economic Analysis
EC 402 Financial Institutions
EC 407 Business Law I
EC 408 Business Law II
EC 409 Introduction to Production
Cost

EC 411 Marketing Methods
EC 414 Tax Accounting
EC 415 Farm Appraisal and Finance
EC 420 Corporation Finance
EC 425 Industrial Management
EC 426 Personnel Management
EC 430 Agricultural Price Analysis
EC 431 Labor Economics
EC 432 Industrial Relations
EC 440 Economic Development
EC 442 Evolution of Economic Ideas

Mathematics:

MA 122 Mathematics of Finance and
Elementary Statistics

GROUP C**APPLIED SCIENCE AND TECHNOLOGY:****Agricultural Communications:**

AC 311 Communications Methods and
Media

Animal Science:

ANS 200 Introduction to Animal Science
ANS 204 Livestock Feeds and Feeding
ANS 302 Selecting Dairy and Meat
Animals
ANS 303 Advanced Selecting Dairy and
Meat Animals

ANS 402 Beef Cattle Management
ANS 403 Swine Management
ANS 404 Dairy Cattle Management
ANS 406 Sheep Management
ANS 409 (FS 409) Meat and Meat Products
ANS 410 Horse Management
ANS 411 Breeding and Improvement of
Domestic Animals
ANS 505 Diseases of Farm Animals
ANS 508 (GN 508) Genetics of Animal
Improvement

Biological and Agricultural Engineering:

BAE 211	Farm Machinery
BAE 321	Irrigation, Terracing and Erosion Control
BAE 331 (FS 331)	Food Engineering
BAE 332	Farm Structures
BAE 341	Farm Electrification and Utilities
BAE 411	Farm Power and Machinery
BAE 433	Crop Preservation and Processing

Crop Science:

CS 211	Crop Science
CS 311	Field Crop Production
CS 312	Pastures and Forage Crops
CS 315	Turf Management
CS 413	Plant Breeding
CS 414	Weed Science
CS 511	Tobacco Technology
CS 513	Physiological Aspects of Crop Production
CS 514 (HS 514)	Principles and Methods in Weed Science

Food Science:

FS 331 (BAE 331)	Food Engineering I
FS 404 (PO 404)	Poultry Products
FS 409 (ANS 409)	Meat and Meat Products

Horticultural Science:

HS 201	Principles of Horticulture
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HS 301	Plant Propagation
HS 342	Landscape Horticulture
HS 421	Fruit Production
HS 432	Vegetable Production
HS 441, 442	Floriculture I and II
HS 481	Breeding of Horticultural Plants

Poultry Science:

PO 201	Poultry Production
PO 301	Poultry Quality Evaluations
PO 351	Poultry Grading
PO 402	Commercial Poultry Enterprises
PO 404 (FS 404)	Poultry Products
PO 520 (GN 520)	Poultry Breeding

Soil Science:

SSC 341	Soil Fertility and Fertilizers
SSC 452	Soil Classification
SSC 461	Soil and Water Conservation
SSC 462	Soil Management Systems
SSC 472	Forest Soils

Zoology:

ZO 212	Basic Anatomy
ZO 213	Basic Physiology
ZO 214	Basic Physiology
ZO 221	Conservation of Natural Resources

GROUP D**SOCIAL SCIENCES AND HUMANITIES:****Anthropology:**

ANT 251	Physical Anthropology
ANT 252	Cultural Anthropology
ANT 305	Peoples of the World

Art:

ART 200	The Visual Arts in Contemporary Life
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Economics:

EC 205	Economic Activity
EC 212	Economics of Agriculture
EC 370 (HI 370)	The Rise of Industrialism
EC 410	Public Finance and Fiscal Policy
EC 413	Competition, Monopoly, and Public Policy
EC 441	Agricultural Development in Foreign Countries
EC 448	International Economics
EC 475	Comparative Economic Systems

English:

Note: These courses may be used as Group D electives if not used to complete the required hours in the language area.

ENG 205	Reading for Discovery
ENG 261, 262	English Literature I, II
ENG 265, 266	American Literature I, II
ENG 346, 347	Comparative Literature I, II
ENG 371	The Modern Novel
ENG 468, 469	American Romanticism, American Realism and Naturalism
ENG 485	Shakespeare

History:

HI 105	Modern Western World
HI 111, 112	The United States Through and Since Reconstruction
HI 207	The Ancient World to 180 A.D.
HI 208	The Middle Ages
HI 215, 216	Latin America To and Since 1826
HI 233	The World in the 20th Century
HI 263, 264	East Asia To and Since 1800
HI 422	Rise of Modern Science

Modern Language:

Any modern language or literature course at the intermediate level or above may be used as a Group D elective if not used to complete the required hours in the language area.

Music:

MUS 200	Music in Contemporary Life
MUS 210	A Survey of Music in America*
MUS 220	Music of the Romantic Period*
MUS 320	Music of the 20th Century*

Philosophy:

PHI 205	Problems and Types of Philosophy
PHI 305	Philosophy of Religion
PHI 306	Philosophy of Art
PHI 307	Morality and Human Happiness
PHI 310	Existentialism
PHI 406	Contemporary Political Philosophy

Politics:

PS 201	The American Governmental System
PS 206	Local Governmental Systems
PS 301	Modern Political Systems: Europe
PS 302	Modern Political Systems: Asia
PS 376	Latin American Government and Politics
PS 472	Soviet Politics
PS 473	Political Systems of New States

Psychology:

PSY 200	Introduction to Psychology
PSY 302	Psychology of Personality and Adjustment
PSY 304	Educational Psychology
PSY 337	Individual Psychology I

Religion:

REL 300	Introduction to Religion
REL 321	Religion in American Life

REL 327**Contemporary Religious Thought****Social Studies:**

SS 301, 302	Science and Civilization I, II
SS 401, 402	Contemporary Issues: The Urban Crisis and The Arms Race

Sociology:

SOC 202	Principles of Sociology
SOC 301	Human Behavior
SOC 302	Mass Communications and Modern Society
SOC 303	Current Social Problems
SOC 304	Contemporary Family Life
SOC 305	Race Relations
SOC 306	Criminology
SOC 341	Rural Society USA
SOC 342	Rural Societies Around the World
SOC 402	Urban Sociology
SOC 411	Community Relationships
SOC 451	Population and Public Affairs

* Presently taught only in Summer School.

ADULT AND COMMUNITY COLLEGE EDUCATION

(Also see education.)

The adult and community college education faculty offers instruction primarily at the graduate level. The department is jointly administered between the School of Agriculture and Life Sciences and the School of Education. For details, see the School of Education, pages 131-132.

AGRONOMY

(See crop science and soil science, pages 89-91 or 110-113.)

ANIMAL SCIENCE

Polk Hall

Professor I. D. PORTERFIELD, Head of the Department

TEACHING AND RESEARCH

Professors: E. R. BARRICK, E. G. BATTE, A. J. CLAWSON, L. GOODE, J. M. LEATHERWOOD, J. G. LECCE, J. E. LEGATES, H. A. RAMSEY, F. H. SMITH, L. C. ULBERG, G. H. WISE; *Adjunct Professor:* J. H. GAINER; *Professors Emeriti:* C. D. GRINNELS, H. A. STEWART; *Associate Professors:* E. V. CARUOLO, D. G. DAVENPORT, E. U. DILLARD, E. J. EISEN, J. J. MCNEILL, R. D. MOCHRIE, D. J. MONCOL, R. M. MYERS, A. H. RAKES, O. W. ROBISON, J. C. WILK; *Assistant Professors:* W. L. ALSMEYER, R. W. HARVEY, W. L. JOHNSON (Peru), E. E. JONES; *Adjunct Assistant Professors:* B. D. HARRINGTON, C. D. LEMUNYAN; *Assistant Professor Emeritus:* J. L. MOORE; *Associate Members of the Faculty:* G. MATRONE, S. B. TOVE (Biochemistry); C. H. HILL (Poultry Science); H. J. GOLD (Statistics)

EXTENSION

Professor A. V. ALLEN, In Charge, Animal Husbandry Extension

Professor M. E. SENGEL, In Charge, Dairy Husbandry Extension

Professors: R. F. BEHLOW, T. C. BLALOCK, J. S. BUCHANAN, G. HYATT, JR., G. S. PARSONS, J. W. PATTERSON; *Professor Emeritus:* J. A. AREY; *Associate Professors:* J. R. JONES, F. N. KNOTT, R. L. MCGUIRE, F. D. SARGENT, D. G. SPRUILL, J. R. WOODARD; *Assistant Professors:* C. M. STANISLAW, D. P. WESEN; *Assistant Professor Emeritus:* R. R. RICH; *Instructors:* K. R. BUTCHER, J. D. DODSON, D. C. PARDUE, C. M. REESE

Undergraduate students in animal science study subjects related to various phases of animal industry. Training is provided in nutrition, physiology, breeding and disease and there are opportunities for the application of basic scientific training in the husbandry areas. Options for course selection by each student make it possible for those of varying backgrounds and wide-ranging interests in the animal field to become involved in training that will be stimulating and rewarding.

OPPORTUNITIES

There are many opportunities for students majoring in animal science. These include farm, dairy and livestock management careers, jobs as fieldmen for breed associations and livestock organizations, agricultural extension, educational work in business and industries serving agriculture, meat grading, agricultural communications in animal science, feed manufacturing, sales work in feeds and equipment, marketing dairy cattle and dairy products, and supervising livestock and farm loans with banks and lending agencies. Many students in veterinary science obtain a degree in animal science as well. In addition, students may elect further study at the graduate level, after which they will find opportunities in teaching, research and development.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in animal science may be obtained under any of the three curricula offered by the School of Agriculture and Life Sciences. For the basic requirements and freshman year, see pages 69-74.

CURRICULA IN ANIMAL SCIENCE

BUSINESS PROGRAM

This curriculum is selected by students desiring a background in business with a technical knowledge of animal science. The program requires the completion of courses in the technology curriculum, page 71, and the economic and business courses as outlined on page 72.

SCIENCE PROGRAM

See the typical curriculum, beginning on page 76.

<i>Departmental Requirements:</i>	<i>Minimum of nine credits from the following courses:</i>
ANS 200 Introduction to Animal Science .. 4	ANS 401 Reproductive Physiology 3
ANS 490 Animal Science Seminar 1	ANS 405 Lactation 3
GN 411 The Principles of Genetics 3	ANS 411 Breeding and Improvement
MB 401 General Microbiology 4	of Domestic Animals 3
ZO 421 Vertebrate Physiology 4	ANS 415 (NTR 415, PO 415)
Departmental Electives 6	Comparative Nutrition 3
	ANS 505 Diseases of Farm Animals 3
	Total Hours—130

TECHNOLOGY PROGRAM

See typical curriculum on page 77.

Departmental Requirements

ANS 200 Introduction to Animal Science ..	4
ANS 204 Livestock Feeds and Feeding	3
ANS 490 Animal Science Seminar	1
GN 411 The Principles of Genetics	3
ZO 421 Vertebrate Physiology	4
Departmental Electives	3

Minimum of nine credits from the following courses:

ANS 401 Reproductive Physiology	3
ANS 405 Lactation	3
ANS 411 Breeding and Improvement of Domestic Animals	3

ANS 415 (NTR 415, PO 415) Comparative Nutrition	3
ANS 505 Diseases of Farm Animals	3
Minimum of five credits from the following courses:	
ANS 302 Selecting Dairy and Meat Animals	2
ANS 402 Beef Cattle Management	3
ANS 403 Swine Management	3
ANS 404 Dairy Cattle Management	3
ANS 406 Sheep Management	3
ANS 410 Horse Management	2
Total Hours—	130

TYPICAL CURRICULUM IN ANIMAL SCIENCE

SCIENCE PROGRAM

For the freshman year see page 69.

SOPHOMORE YEAR

First Semester	Credits	Second Semester	Credits
ANS 200 Introduction to Animal Science ..	4	ANS 204 Livestock Feeds & Feeding	3
CH 220 Introductory Organic Chemistry*		CH 223 Organic Chemistry II	
or		or	
CH 221 Organic Chemistry I	4	Group A Elective	4
MA 212 Anal. Geo. & Calc. B	3	EC 205 Economic Activity	3
SP 231 Expository Speaking	3	PY 221 College Physics	5
Free Elective	3	Physical Education	1
Physical Education	1		16
	18		

* The students choice of CH 220 or CH 221 is dependent upon his previous completion of either CH 103 General Chemistry II or CH 107 Principles of Chemistry.

JUNIOR YEAR

First Semester	Credits	Second Semester	Credits
BCH 351 Elementary Biochemistry	3	ANS 409 (FS 409) Meat & Meat Products ..	3
EC 212 Economics of Agriculture	3	ANS 415 (NTR 415, PO 415) Comparative Nutrition	3
PS 201 The American Govt. System	3	ENG 205 Reading for Discovery	3
ZO 421 Vertebrate Physiology	4	GN 411 The Principles of Genetics	3
Free Elective	3	MB 401 General Microbiology	4
	16		16

SENIOR YEAR

First Semester	Credits	Second Semester	Credits
ANS 411 Breeding & Improvement of Domestic Animals	3	ANS 401 Reproductive Physiology	3
ANS 505 Diseases of Farm Animals	3	ANS 402 Beef Cattle Management	3
Animal Science Elective	2	ANS 403 Swine Management	3
SOC 301 Human Behavior	3	ANS 490 Animal Science Seminar	1
Group D Elective	3	PSY 200 Intro. to Psychology	3
Free Elective	3	Free Elective	3
	17	Total Hours—	130

TYPICAL CURRICULUM IN ANIMAL SCIENCE TECHNOLOGY PROGRAM

For the freshman year see page 69.

SOPHOMORE YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
ANS 200 Introduction to Animal Science . . .	4	ANS 204 Livestock Feeds & Feeding	3
CH 220 Introductory Organic Chemistry . . .	4	EC 212 Economics of Agriculture	3
EC 205 Economic Activity	3	PY 221 College Physics	5
SP 231 Expository Speaking	3	SSC 200 Soils	4
Physical Education	1	Physical Education	1
	15		16

JUNIOR YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
ANS 302 Selecting Dairy & Meat Animals . . .	2	ANS 308 Advanced Selecting Dairy & Meat Animals	1
ANS 505 Diseases of Farm Animals	3	ANS 402 Beef Cattle Management	3
ENG 205 Reading for Discovery	3	CS 312 Pastures & Forage Crops	3
PS 201 The American Govt. System	3	GN 411 The Principles of Genetics	3
ZO 421 Vertebrate Physiology	4	PSY 200 Introduction to Psychology	3
Groups A, B or C Elective	3	or	
	18	Group D Elective	3
		Free Electives	5
			18

SENIOR YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
ANS 406 Sheep Management	3	ANS 401 Reproductive Physiology	3
ANS 411 Breeding & Improvement of Domestic Animals	3	ANS 403 Swine Management	3
SOC 301 Human Behavior	3	ANS 409 (FS 409) Meat & Meat Products	3
Group D Elective	3	ANS 490 Animal Science Seminar	1
Free Elective	4	EC 312 Accounting I	1
	16	or	
		Group A, B or C Elective	3
		Free Elective	3
			16

Total Hours—130

GRADUATE STUDY

The department offers the Master of Science and the Doctor of Philosophy degrees in animal husbandry, dairy husbandry, animal biochemistry and nutrition, animal diseases, animal physiology and animal breeding. Prospective applicants should consult the Graduate School Catalog.

BIOCHEMISTRY

Polk Hall

Professor GENNARD MATRONE, *Head of the Department*

Professors: F. B. ARMSTRONG, I. S. LONGMUIR, A. R. MAIN, S. B. TOVE; *Associate Professors:* H. R. HORTON, J. S. KAHN, E. C. SISLER; *Assistant Professor:* J. A. KNOPP; *Visiting Assistant Professor:* CAROL R. KEPLER; *Instructor:* ELIZABETH C. THEIL; *Associate Members of the Faculty:* E. E. JONES (Animal Science); J. BORDNER, S. G. LEVINE, W. P. TUCKER (Chemistry); L. W. AURAND (Food Science)

The Department of Biochemistry offers instruction at advanced undergraduate and graduate levels. The undergraduate courses are designed to support the

other departments of the University, providing students with a fundamental background in the science of biochemistry. The graduate program is designed to train scientists for research and teaching careers in biochemistry and related fields.

The Department of Biochemistry is jointly administered in the School of Agriculture and Life Sciences and the School of Physical and Mathematical Sciences.

UNDERGRADUATE CURRICULUM

The department offers an undergraduate curriculum leading to the B.S. degree in biological sciences with an option in biochemistry. See below and pages 71-72.

BIOLOGICAL SCIENCES CURRICULUM

BIOCHEMISTRY EMPHASIS

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I	4	CH 107 Principles of Chemistry	4
CH 106 Laboratory Techniques I	1	CH 108 Laboratory Techniques II	1
MA 102 Analytic Geometry and Calculus I	4	MA 201 Analytic Geometry and Calculus II	4
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
ALS 103 Orientation	1	BS 100 General Biology	4
Humanities—Social Sciences Elective	3	Physical Education	1
Physical Education	1		17
	17		

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I	4	CH 223 Organic Chemistry II	4
MA 202 Analytic Geometry and Calculus III	4	BO 200 Plant Life	4
Modern Language or English Elective	3	Humanities—Social Sciences Elective	3
ZO 201 Animal Life	4	Modern Language or English Elective	3
Physical Education	1	Physical Education	1
	16		15

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 428 Qualitative Organic Analysis	3	BCH 351 Elementary Biochemistry	3
MA 301 Applied Differential Equations I	3	CH 431 Physical Chemistry I	3
BO 360 (ZO 360) Introduction to Ecology	4	GN 411 The Principles of Genetics	3
PY 211 General Physics	4	GN 412 Elem. Genetics Laboratory	1
Humanities—Social Sciences Elective	3	PY 212 General Physics	4
	17	Humanities—Social Sciences Elective	3
			17

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BCH 452 Experimental Biochemistry	3	MB 401 General Microbiology	4
CH 433 Physical Chemistry II		ST 311 Introduction to Statistics	
or		or	
CH 435 Physical Chemistry III	3	CSC 111 Algorithmic Languages I	
BO 421 Plant Physiology		or	
or		Mathematics Elective	2-3
ZO 421 Vertebrate Physiology		Humanities—Social Sciences Electives	6
or		Free Electives	3-4
ZO 414 (BO 414) Cell Biology	4		15-17
Humanities—Social Sciences Elective	3		
Free Electives	3-4		
	16-17		

Total Hours—130

GRADUATE STUDY

The Department of Biochemistry offers programs of study leading to the Master of Science and Doctor of Philosophy degrees. Prospective students should consult the Graduate School Catalog for additional information.

BIOLOGICAL AND AGRICULTURAL ENGINEERING

(Also see Engineering.)

David S. Weaver Laboratories

Professor F. J. HASSLER, Head of the Department

TEACHING AND RESEARCH

Professors: H. D. BOWEN, J. M. FORE, D. H. HOWELLS, W. H. JOHNSON, C. W. SUGGS; Professor Emeritus: J. W. WEAVER, JR.; Associate Professors: G. B. BLUM, JR., J. W. DICKENS (USDA), E. L. HOWELL, B. K. HUANG, E. G. HUMPHRIES, W. F. MCCLURE, C. R. WILLEY (USDA), R. E. WILLIAMSON (USDA), E. H. WISER, J. H. YOUNG; Assistant Professors: J. R. HAMMERLE, R. G. HOLMES, F. J. HUMENIK, R. P. ROHRBACK, R. W. SKAGGS, R. S. SOWELL, T. B. WHITAKER (USDA); Assistant Professor Emeritus: N. W. WELDON; Associate Members of the Faculty: D. D. HAMANN, V. A. JONES (Food Science)

EXTENSION

Associate Professor G. J. KRIZ, Associate Head In Charge of Extension

Professor Emeritus: H. M. ELLIS; Associate Professors: L. B. DRIGGERS, W. C. WARRICK; Associate Professor Emeritus: J. C. FERGUSON; Assistant Professors: E. O. BEASLEY, J. W. GLOVER, R. W. WATKINS; Instructor: R. E. SNEED

Students in biological and agricultural engineering are educated and trained to deal with problems of agriculture that are engineering in nature. Involved are the application of scientific and engineering principles to the conservation and utilization of water and soil, the development of power and labor-saving devices for all phases of agricultural production, the design of structures and equipment for housing and handling livestock and field products, and the processing and marketing of farm products.

The need for men to carry out the technical aspects such as development and research as well as less technical work, such as sales and service of farm equipment requires the offering of two distinct curricula as described below.

The curricula lead to the Bachelor of Science degree.

OPPORTUNITIES

Men trained in biological and agricultural engineering under the science curriculum are qualified for positions in design, development and research in public institutions and in industry, and for teaching and extension work in institutions of higher education. The curriculum also provides adequate training for post-graduate work leading to advanced degrees.

Men trained in the field of agricultural engineering technology are qualified for positions in sales and service of agricultural equipment such as farm machinery, irrigation systems, etc.; as county agents or farmers; and for farm advisory work with such organizations as electric power companies.

CURRICULUM IN BIOLOGICAL AND AGRICULTURAL ENGINEERING

SCIENCE PROGRAM

This curriculum, offered in conjunction with the School of Engineering, is designed to develop young men capable of engineering leadership in agriculture. Emphasis is placed on basic science courses such as mathematics, physics, mechanics, biology, soils, and thermodynamics, which provide a sound background for engineering and agricultural technology. Courses in biological and agricultural engineering are directed to those methods of thought and techniques whereby science can be applied with understanding and judgment to engineering situations in agricultural operations. General agriculture courses are provided in order that the student can better understand the agricultural industry with which he deals.

Since biological and agricultural engineering involves two distinct technical fields—agriculture and engineering—this curriculum is a joint responsibility of the two schools and is so administered. Graduates in the program receive the degree of Bachelor of Science in biological and agricultural engineering.

For the freshman year program in agricultural engineering science, refer to the common freshman year in the School of Engineering on page 147.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BAE 251 Elements of Bio. & Agr. Engr.	3	BS 100 General Biology	4
CSC 111 Algorithmic Lang. I	2	EE 331 Princ. of Elect. Engr.	3
EM 205 Princ. of Engr. Mech.	3	EM 305 Engineering Dynamics	3
MA 202 Analytic Geometry and Calculus III	4	Humanities & Soc. Sci.	3
PY 208 General Physics	4	MA 301 Applied Differential Equations	3
Physical Education	1	Physical Education	1
	<hr/> 17		<hr/> 17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BAE 361 Analytical Methods	3	BAE 342 Agr. Processing	4
BAE 391 Electrotechnology in Bio. & Agr. Engr.	3	BAE 381 Agri. Structures & Env.	3
EM 301 Solid Mechanics I	3	BAE 462 Functional Design of Field Mach.	3
MAE 301 Engr. Thermodynamics I	3	Humanities & Soc. Sci.	3
SSC 200 Soils	4	Free Elective	3
	<hr/> 16		<hr/> 16

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BAE 451 Agr. Engr. Design I	3	BAE 452 Agr. Engr. Design II	3
BAE 472 Agri. Water Management	4	Advised Tech. Elec.	3
Humanities & Soc. Sci.	6	Humanities & Soc. Sci.	6
Free Elective	3	Free Elective	3
	<hr/> 16		<hr/> 16

Total Hours—129

Humanities and social sciences will be taken according to the standard engineering school listing.

CURRICULUM IN BIOLOGICAL AND AGRICULTURAL ENGINEERING

TECHNOLOGY PROGRAM

This curriculum is designed for those who are working on a practical level with farm people. Graduates are equipped to apply to the farm the new tech-

nology as developed and revealed by the research engineer. The courses are presented and directed toward the solution of consumer problems with emphasis on the techniques employed. Graduates from this program will receive the degree of Bachelor of Science in agriculture.

Listed below are the departmental requirements in the technology program and a typical curriculum in this program.

<i>Departmental Requirements* (26 Credits)</i>			
BAE 211 Farm Machinery	4	BAE 332 Farm Structures	3
BAE 303 Energy Conversion for Agricultural Production	2	BAE 341 Farm Electrification and Utilities	3
BAE 321 Irrigation, Terracing, and Erosion Control	3	BAE 411 Farm Power and Machinery	3
BAE 331 (FS 331) Food Engineering	3	BAE 433 Crop Preservation and Processing	3
		E 101 Engineering Graphics I	2

*PY 211, 212 will be taken in place of PY 221 as shown in the agricultural technology curriculum. These three additional credits are Group A electives required by the department.

TYPICAL CURRICULUM IN AGRICULTURAL ENGINEERING TECHNOLOGY

For the freshman year see page 147.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BAE 211 Farm Machinery	4	BAE 341 Farm Electrification & Utilities	3
CH 101 General Chem. I	4	CH 103 Gen. Chemistry II	4
PY 211 Gen. Physics*	4	PY 212 General Physics	4
SP 231 Expository Sp.	3	SSC 200 Soils	4
Physical Education	1	Physical Education	1
	<u>16</u>		<u>16</u>

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BAE 303 Energy Conversion for Agric. Production	2	BAE 321 Irrigation, Terracing & Erosion Control	3
BAE 331 (FS 331) Food Engineering	3	EC 212 Economics of Agriculture	3
E 101 Engineering Grap. I	2	Free Elective	3
EC 205 Economic Activity	3	Group D Elective	3
Modern Language or		SOC 202 Principles of Sociology	3
English Elective	3		<u>15</u>
Group D Elective	3		
	<u>16</u>		

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BAE 433 Crop Preservation & Processing	3	BAE 332 Farm Structures	3
Free Elective	3	BAE 411 Farm Power & Machinery	3
Group A, B or C Electives	12	Free Electives	6
	<u>18</u>	Group A, B or C Electives	6
			<u>18</u>

Total Hours—130

GRADUATE STUDY

The department offers programs of study for the Master of Science, Doctor of Philosophy and Master of Biological and Agricultural Engineering degrees. Prospective applicants should consult the Graduate School Catalog.

BIOLOGICAL SCIENCES

Gardner Hall

C. F. LYTLE, *Major Adviser*

The Biological Sciences Curriculum is an interdepartmental program designed to serve the needs of students desiring a comprehensive training in biology rather than specialization in some specific field of the biological sciences. It is especially suitable for students preparing for graduate study in a specialized field of biology as well as for students planning to teach high school biology. Also, students preparing for careers in business or industry and wishing a broad, general training in biology may find the Biological Sciences Curriculum suitable for their needs.

Experience has indicated that one of the best preparations for graduate study in biology is a broad training in the basic biological sciences supplemented with a strong background in the physical sciences and other supporting areas. The Biological Sciences Curriculum incorporates these features and provides the student with maximum flexibility and options for specialization at the graduate level.

Because of its emphasis on a strong preparation in the physical and biological sciences and on preparation for graduate study, the Biological Sciences Curriculum is a rigorous program requiring several courses in chemistry, physics, mathematics and foreign language. Those students whose interests and aptitudes fall primarily in some specific area of the biological sciences should elect one of the departmental majors such as botany, zoology or entomology.

Students wishing to concentrate their studies within a specific field can do so in the Biological Sciences Curriculum by selecting appropriate elective courses in consultation with their advisers. Programs within the Biological Sciences Curriculum are available to provide emphasis in biochemistry, botany, entomology, microbiology, zoology and biology teaching.

COURSE REQUIREMENTS IN THE BIOLOGICAL SCIENCES CURRICULUM

		Credits			
ALS 103	Orientation	1			
			<i>Biological Sciences</i>		
			<i>(31 Credits)</i>		
ENG 111	Composition and Rhetoric	3			Credits
ENG 112	Composition and Reading	3	BCH 351	Elementary Biochemistry	3
Modern Language (200 level)		6	BO 200	Plant Life	4
			BO 360 (ZO 360)	Introduction to Ecology	4
<i>Social Sciences and Humanities</i>			BO 421	Plant Physiology	
<i>(21 Credits)</i>			or		
Electives		21	ZO 421	Vertebrate Physiology	
			or		
<i>Physical Sciences and Mathematics</i>			BO 414 (ZO 414)	Cell Biology	4
<i>(34-36 Credits)</i>			BS 100	General Biology	4
CH 101	General Chemistry I	4	GN 411	The Principles of Genetics	3
CH 107	Principles of Chemistry	4	GN 412	Elementary Genetics Lab	1
CH 221	Organic Chemistry I	4	MB 401	General Microbiology	4
CH 223	Organic Chemistry II	4	ZO 201	Animal Life	4
MA 114	Topics in Modern Math	3			
MA 112	Analytic Geometry and Calculus A	4	<i>Electives (25-27 Credits)</i>		
MA 212	Analytic Geometry and Calculus B	3	Restricted Electives from Groups		
or			A, B, C and D		13-15
MA 102	Analytic Geometry and Calculus I	4	Free Electives		12
MA 201	Analytic Geometry and Calculus II	4	Subtotal		126
MA 202	Analytic Geometry and Calculus III	4	Physical Education		4
PY 211	General Physics	4	Total Hours—130		
PY 212	General Physics	4			

TYPICAL CURRICULA IN BIOLOGICAL SCIENCES

For the freshman year see page 69.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 200 Plant Life	4	CH 223 Organic Chemistry II	4
CH 221 Organic Chemistry I	4	ZO 201 Animal Life	4
MA 202 Analytic Geometry and Calculus III	4	Group D Elective	3
or		Free Elective	3
MA 212 Analytic Geometry and Calculus B	3	Physical Education	1
Group D Electives	3		15
Physical Education	1		
	15-16		

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 360 (ZO 360) Introduction to Ecology ..	4	BCH 351 Elementary Biochemistry	3
PY 211 General Physics	4	GN 411 The Principles of Genetics	3
Modern Language (200 level)	3	GN 412 Elementary Genetics Lab	1
Group D Elective	3	PY 212 General Physics	4
Free Elective	3	Modern Language (200 level)	3
	17	Group D Elective	3
			17

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 421 Plant Physiology		MB 401 General Microbiology	4
or		Restricted Elective	3
ZO 421 Vertebrate Physiology		Free Electives	9
or			16
BO 414 (ZO 414) Cell Biology	4	Total Hours—130	
Group D Elective	3		
Restricted Electives	10		
	17		

BIOCHEMISTRY EMPHASIS

For the freshman year see page 69.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I	4	BO 200 Plant Life	4
MA 202 Analytic Geometry and Calculus III	4	CH 223 Organic Chemistry II	4
Modern Language (200 level)	3	Modern Language (200 level)	3
ZO 201 Animal Life	4	Group D Electives	6
Physical Education	1	Physical Education	1
	16		18

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 360 (ZO 360) Introduction to Ecology ..	4	BCH 351 Elementary Biochemistry	3
CH 428 Qualitative Organic Analysis	3	CH 431 Physical Chemistry I	3
MA 301 Applied Differential Equations I ..	3	GN 411 The Principles of Genetics	3
PY 211 General Physics	4	GN 412 Elementary Genetics Laboratory ..	1
Group D Elective	3	PY 212 General Physics	4
	17	Group D Elective	3
			17

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BCH 452 Experimental Biochemistry	3	ST 311 Introduction to Statistics	
BO 421 Plant Physiology		or	
or		CSC 111 Algorithmic Languages I	
ZO 421 Vertebrate Physiology		or	
or		Mathematics Elective	2-3
ZO 414 (BO 414) Cell Biology	4	MB 401 General Microbiology	4
CH 433 Physical Chemistry II		Group D Electives	6
or		Free Elective	3
CH 435 Physical Chemistry III	3		
Group D Elective	3		15-16
Free Elective	3		Total Hours—130
	16		

MICROBIOLOGY EMPHASIS

For the freshman year see page 69.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 200 Plant Life	4	BCH 351 Elementary Biochemistry	3
CH 221 Organic Chemistry I	4	CH 223 Organic Chemistry II	4
MA 202 Analytic Geometry and		Modern Language (200 level)	3
Calculus III	4	ZO 201 Animal Life	4
Modern Language (200 level)	3	Physical Education	1
Physical Education	1		15
	16		

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 360 (ZO 360) Introduction		GN 411 The Principles of Genetics	3
to Ecology	4	GN 412 Elementary Genetics Lab	1
BO 414 (ZO 414) Cell Biology	4	MB 401 Microbiology	4
PY 211 General Physics	4	PY 212 General Physics	4
Group D Electives	6	Group D Electives	6
	18		18

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BCH 452 Experimental Biochemistry	3	MB 514 Microbiology Metabolism	4
MB 501 Advanced Microbiology	4	Group D Elective	3
Group D Elective	3	Free Electives	7
Restricted Elective	4		14
Free Elective	3		Total Hours—130
	17		

BIOLOGY TEACHING

For the freshman year see page 69.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 200 Plant Life	4	CH 223 Organic Chemistry II	4
CH 221 Organic Chemistry I	4	ED 203 Introduction to Teach.	
MA 212 Analytic Geometry		Math. & Science*	2
and Calculus B	3	ZO 201 Animal Life	4
PSY 200 Introduction to Psychology	3	Group D Electives	6
Group D Elective	3	Physical Education	1
Physical Education	1		17
	18		

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 360 (ZO 360) Introduction to Ecology	4	BCH 351 Elementary Biochemistry	3
BO 414 (ZO 414) Cell Biology	4	GN 411 The Principles of Genetics	3
ED 344 Secondary Education*	3	GN 412 Elementary Genetics Lab	1
Modern Language (200 level)	3	Modern Language (200 level)	3
PY 211 General Physics	4	PSY 304 Educational Psychology	3
	18	PY 212 General Physics	4
			17

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 420 Principles of Guidance*	2	MB 401 General Microbiology	4
ED 475 Methods of Teaching Science*	3	Restricted Electives	8
ED 476 Student Teaching in Science*	6	Group D Elective	3
ED 477 Developing and Selecting Teaching Materials in Science*	2		
PSY 476 Psychology Adolescence	2		
	15		15
			Total Hours—130

* These courses (total of 18 hours) must be selected in lieu of free electives to complete requirements for a teaching certificate.

BOTANY

Gardner Hall

Professor G. R. NOGGLE, Head of the Department

Professors: A. W. COOPER, R. J. DOWNS, J. W. HARDIN, H. T. SCOFIELD, J. R. TROYER; Adjunct Professors: W. W. HECK, J. A. YARBROUGH; Professors Emeriti: B. W. WELLS, L. A. WHITFORD; Associate Professors: C. E. ANDERSON, H. E. PATTEE (USDA), H. E. SCHLICHTING, JR., H. SELTMANN (USDA); Adjunct Associate Professor: D. W. DEJONG; Assistant Professors: U. BLUM, R. C. FITES, S. D. KOCH, R. T. MOORE, E. D. SENECA, C. G. VAN DYKE; Instructors: R. A. BRADY, LINDA M. STROUD, A. M. WITHERSPOON; Associate Members of the Faculty: J. S. KAHN (Biochemistry); R. E. WILLIAMSON (USDA) (Biological and Agricultural Engineering); D. E. MORELAND (USDA) (Crop Science); D. H. TIMOTHY (Crop Science, Genetics); C. L. MCCOMBS (Horticultural Science); J. A. WARREN (Statistics); R. J. THOMAS (Wood and Paper Science); B. J. COPELAND (Zoology)

The course program in botany has the objective of providing undergraduate and graduate instruction in plant science. Undergraduates majoring in the department are generally oriented toward graduate work in plant science or some other biological field. Qualified undergraduates are encouraged to participate in independent research. Graduate programs provide opportunities for students studying for master's or doctoral degrees. Course work in the department also provides a basis for study in the applied fields of agriculture, resource development and forestry.

OPPORTUNITIES

Majors in botany may choose to continue graduate work leading to the Master of Science and Doctor of Philosophy degrees. There is a great need for persons with advanced training in botany for teaching positions in junior colleges, colleges and universities, and for research positions in government and private laboratories. Majors specializing in botany with a B.S. degree are qualified for many technical positions in government and industrial laboratories, as well as for positions as field botanists, naturalists, etc.

UNDERGRADUATE CURRICULUM

The Bachelor of Science degree with a major in botany is offered under the science curriculum of the School of Agriculture and Life Sciences. The program for the freshman year is shown on page 69, and the other basic requirements are listed on pages 69-74.

TYPICAL CURRICULUM IN BOTANY

SCIENCE PROGRAM

SOPHOMORE YEAR		JUNIOR YEAR	
BO 403 Systematic Botany	4	BO 421 Plant Physiology	4
CH 101 General Chemistry I	4	CH 220 Introductory Organic Chemistry	4
CH 103 General Chemistry II	4	GN 411 The Principles of Genetics	3
Language Electives	6	GN 412 Elementary Genetics Lab	1
Social Science Elective	3	Humanities Electives	6
SSC 200 Soils	4	PY 221 College Physics	5
ZO 201 Animal Life	4	Science Elective	4
Physical Education	2	Electives	8
	31		35
SENIOR YEAR			
BO 360 (ZO 360) Introduction to Ecology	4		
BO 400 Plant Diversity	3		
MB 401 General Microbiology	4		
Electives	23		
	34		
Total Hours—130			

GRADUATE STUDY

The department offers work leading to the Master of Botany, Master of Science and Doctor of Philosophy degrees. Prospective applicants should consult the Graduate School Catalog.

CONSERVATION

(Also see forest resources.)

Williams, Gardner and Kilgore Halls.

M. G. COOK, *Major Adviser, School of Agriculture and Life Sciences*

L. C. SAYLOR, *Major Adviser, School of Forest Resources*

Conservation is the wise use, preservation or improvement of natural resources, without waste for the long-time benefit of man. This degree program in conservation is offered jointly by the School of Agriculture and Life Sciences and by the School of Forest Resources. Faculty members in the Departments of Botany, Entomology, Forestry, Plant Pathology, Recreational Resources Administration, Soil Science and Zoology are directly involved in various aspects of education in conservation.

Rapid urbanization and industrialization, plus an increase in population are bringing increased pressures on the use of land areas for recreation as well as food, fiber and wood production. These trends have created the acute need for people trained to make sound judgements in the management of natural resources.

Conservationists must be able to view problems from several aspects rather than from a narrow vision. This phase of conservation has been called a philosophy rather than a discipline. However, for the conservationist to apply this philosophy to problem-solving in a modern society, he must be well-trained in the basic concepts of several disciplines.

OPPORTUNITIES

Needed in increasing numbers are conservationists who are trained in the management of (1) wildlands for water, fish and game production, (2) intensively used agricultural and forested areas, and (3) areas of concentrated human habitation.

UNDERGRADUATE CURRICULUM

Students will enroll in either of the two schools depending on the primary area of interest in conservation. The freshman common core of courses for either school is acceptable. All students will take a prescribed core of subjects in conservation. Conservation is recommended as a second degree although the program may be pursued as the only degree. Students desiring a strong background in a particular area may obtain a dual degree by the appropriate use of electives. Specialists in soils, wildlife biology, forest management and other selected areas are developed through the proper choice of courses.

REQUIRED AND ELECTIVE COURSES IN CONSERVATION

<i>Departmental Requirements:</i>		<i>Biological Science Requirements:</i>	
	<i>Credits</i>		<i>Credits</i>
FOR 472 Renewable Resource Management	3	BS 100 General Biology	4
GY 120 Physical Geology	3	BO 200 Plant Life	4
RRA 341 Recreation Resources Relationships	3	or	
SSC 206 Soils	4	ZO 201 Animal Life	4
ZO 221 Conservation of Natural Resources	3	BO 360 (ZO 360) Introduction to Ecology	4
ZO 353 Wildlife Management	3	Electives*	9
Conservation Electives	12		21
	31		
<i>Departmental Electives:</i>		<i>English, Humanity and Social Science Requirements:</i>	
BAE 471 Soil and Water Conservation Engineering	3	ENG 111, 112 Composition	6
BO 403 Systematic Botany	4	English Electives	6
BO 544 Plant Geography	3	Humanity-Social Science Electives	21
FOR 452 Silvics	4		33
FOR 572 Conservation Policy Issues	3	<i>Math and Physical Sciences:</i>	
GY 208 Physical Geography and Meteorology	3	CH 101, 103 General Chemistry I, II	8
GY 222 Historical Geology	3	MA 111 Algebra and Trigonometry and either	
GY 486 Weather and Climate	2	MA 114 Topics in Modern Math	
RRA 441 Recreation Resource Development	3	or	
RRA 442 Wildland Recreation Environments	3	MA 112 Analytic Geometry and Calculus A	
SSC 341 Soil Fertility and Fertilizers	3	or	
SSC 461 Soil and Water Conservation	3	MA 102 Analytic Geometry and Calculus I	7-8
SSC 472 Forest Soils	3	PY 221 College Physics	5
ZO 501 Ornithology	3	or	
ZO 420 Fishery Science	3	PY 211, 212 General Physics	8
ZO 544 Mammalogy	3	ST 311 Statistics	3
		or	
		MA 114 Modern Math	
			23
		Orientation	1
		Physical Education	4
		Electives	15
			20
		Total Hours—128	

* These biological science electives would vary to meet requirements of different departments; they would include such courses as botany, entomology, genetics, physiology, plant pathology and zoology.

TYPICAL CURRICULUM IN CONSERVATION

SCIENCE PROGRAM

For the freshman year see page 69.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 103 General Chemistry II	4	BO 200 Plant Life	
GY 120 Physical Geology	3	or	
Humanities—Social Sciences Elective	3	ZO 201 Animal Life	4
ZO 221 Conservation of Natural		English Elective	3
Resources	3	Humanities—Social Sciences Elective	3
Free Elective	3	SSC 200 Soils	4
Physical Education	1	Physical Education	1
	<u>17</u>		<u>15</u>

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 360 (ZO 360) Introduction		Biological Sciences Elective	3
to Ecology	4	Conservation Elective	3
Conservation Elective	4	Humanities & Social Sciences Elective	3
FOR 472 Renewable Resource Mgmt.	3	PY 221 College Physics	5
Humanities—Social Sciences Elective	3	RRA 341 Recreation Resource	
ST 311 Introduction to Statistics	3	Relationships	3
	<u>17</u>		<u>17</u>

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Biological Sciences Elective	3	Biological Sciences Elective	3
Conservation Elective	3	Conservation Elective	3
English Elective	3	Humanities & Social Sciences Elective	3
ZO 353 Wildlife Management	3	Free Electives	6
Free Electives	5		<u>15</u>
	<u>17</u>		Total Hours—128

CURRICULUM IN CONSERVATION (Wildlife Concentration)

SCIENCE PROGRAM

For the freshman year see page 69.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
English or Language Elective		English or Language Elective	3
(Literature)	3	Soc. Sci. or Humanity	6
GY 120 Physical Geology	3	SSC 200 Soils	4
PS 201 The American Govt. Syst.	3	ZO 221 Cons. of Nat. Res.	3
Soc. Sci. or Humanity	3	Physical Education	1
ZO 201 Animal Life	4		<u>17</u>
Physical Education	1		
	<u>17</u>		

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 200 Plant Life	4	ST 311 Intro. to Statistics	3
FOR 472 Renewable Res. Mgt.	3	Soc. Sci. or Humanity	6
PY 221 College Physics	5	ZO 351 Vert. Zoology	4
ZO 360 (BO 360) Intro. to Ecology	4	Advised Elective	4
	<u>16</u>		<u>17</u>

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ZO 353 Wildlife Management	3	GN 411 The Prin. of Genetics	3
ZO 420 Fishery Science	3	RRA 341 Recreation Resource	
ZO 501 Ornithology	3	Relationships	3
Free Electives	6	ZO 544 Mammalogy	3
	15	Free Electives	6
			15

Total Hours—130

For the student who is interested in conservation and communication, the following courses in communication are available:

AC 311 Communications Methods	3
ENG 215 Principles of News and	
Article Writing	3
Technical Information	3
ENG 321 The Communication of	
ENG 496 Literary Analysis	
(Sen. Sem.)	3
SP 350 Fundamentals of Radio	
Broadcasting	3

CROP SCIENCE

Williams Hall

Professor P. H. HARVEY, Head of the Department

TEACHING AND RESEARCH

Professors: C. A. BRIM (USDA), D. S. CHAMBLEE, J. F. CHAPLIN (USDA), W. K. COLLINS, D. A. EMERY, D. U. GERSTEL, W. C. GREGORY, H. D. GROSS, G. L. JONES, K. R. KELLER, J. A. LEE (USDA), W. M. LEWIS, T. J. MANN, P. A. MILLER, R. P. MOORE, D. E. MORELAND (USDA), L. L. PHILLIPS, J. C. RICE, D. L. THOMPSON (USDA), D. H. TIMOTHY, J. A. WEYBREW, A. D. WORSHAM; *Professor Emeritus:* G. K. MIDDLETON; *Associate Professors:* T. H. BUSBICE (USDA), W. A. COPE (USDA), W. T. FIKE, JR., W. B. GILBERT, G. R. GWYNN (USDA), C. F. MURPHY, J. B. WEBER, E. A. WERNSMAN; *Assistant Professors:* J. C. BURNS (USDA), F. T. CORBIN, J. L. HALL, R. C. LONG, R. P. PATTERSON, J. W. SCHRADER, C. F. TESTER (USDA); *Visiting Assistant Professor:* KAZUO KAWANO (Peru); *Instructors:* D. T. GOODEN, III, T. H. NUNALEE, J. C. WYNNE; *Associate Members of the Faculty:* E. C. SISLER (Biochemistry); T. J. SHEETS (Entomology, Horticultural Science)

EXTENSION

Professor G. L. JONES, In Charge of Agronomy Extension

Professors: C. T. BLAKE, S. H. DOBSON, S. N. HAWKS, JR., F. W. McLAUGHLIN, A. PERRY, A. D. STUART; *Professors Emeriti:* R. R. BENNETT, E. R. COLLINS; *Associate Professors:* H. F. ROSS, W. G. TOOMEY; *Assistant Professors:* J. G. CLAPP, JR., H. D. COBLE, E. L. KIMBROUGH; *Assistant Professor Emeritus:* R. H. CROUSE

The rapid increase in human populations, the continuing evolution of pests and diseases, the challenge of new natural and artificial environments and the decrease of farm land are all critical and current world issues.

The curricula in this department are designed to give the crop science major an awareness and a sense of personal involvement in these issues. The student

receives a working knowledge of the fundamental principles of plant science which tend to shape modern crop production practices. He is also trained in the economics of various crop management procedures which may influence long-range investments.

OPPORTUNITIES

With cash crops returning nearly one billion dollars to the annual farm income of North Carolina, the opportunities within the state for crop science graduates in county extension programs, in farm management, as salesmen of seed and agricultural chemicals and in the several governmental agencies remain high. Demand for qualified students in national and international concerns is increasing.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in crop science is offered under the business and science curricula of the School of Agriculture and Life Sciences. Students may also earn the degree of Bachelor of Science under the technology curriculum with a major in agronomy. The agronomy option is administered jointly by the Departments of Crop Science and Soil Science.

For the freshman year and basic requirements see pages 69-74.

CURRICULA IN CROP SCIENCE

BUSINESS PROGRAM

Refer to page 70.

SCIENCE PROGRAM

	<i>Credits</i>		<i>Credits</i>
<i>Physical and Biological Sciences</i>		<i>Electives in A, B or C Courses</i>	
BO 200 Plant Life	4	<i>Departmental Requirements and</i>	
<i>Group A, B, & C Courses (25 Credits)</i>		<i>Electives (26 Credits)</i>	
CH 221 Organic Chemistry I	4	BO 421 Plant Physiology	4
CH 223 Organic Chemistry II	4	CS 211 Crop Science	3
GN 411 The Principles of Genetics	3	CS 214 Crop Science Laboratory	1
GN 412 Elementary Genetics Laboratory	1	CS 311 Field Crop Production	
MA 111 Algebra and Trigonometry	4	or	
MA 112 Analytic Geometry and		CS 312 Pastures and Forage Crops	3
Calculus A	4	CS 414 Weed Science	3
MA 114 Topics in Modern Math		CS 490 Senior Seminar	1
or		ENT 312 Introduction to Economic	
MA 212 Analytic Geometry and		Insects	3
Calculus B	3	SSC 200 Soils	4
MB 401 General Microbiology	4	Soil Science Electives	3
PP 315 Plant Diseases	3	Elective	1
		Total Hours—180	

CURRICULUM IN AGRONOMY*

TECHNOLOGY PROGRAM

	<i>Credits</i>		<i>Credits</i>
<i>Physical and Biological Sciences</i>		<i>CS 311 Field Crop Production</i>	
BO 421 Plant Physiology	4	or	
<i>Group A, B & C Courses</i>		CS 312 Pastures and Forage Crops	3
<i>(20-21 Credits)</i>		CS 413 Plant Breeding	3
CH 220 Introductory Organic Chemistry	4	CS 414 Weed Science	3
GN 411 The Principles of Genetics	3	CS 490 Senior Seminar	1
PP 315 Plant Diseases	3	SSC 341 Soil Fertility and Fertilizers	3
Electives	10 or 11	SSC 452 Soil Classification	3
<i>Departmental Requirements and</i>		SSC 461 Soil and Water Conservation	3
<i>Electives (27 Credits)</i>		Electives	4
CS 211 Crop Science	3	Total Hours—180	
CS 214 Crop Science Laboratory	1		

* The agronomy major is administered by the Departments of Crop Science and Soil Science and is listed jointly.

PLANT PROTECTION

The Departments of Crop Science, Entomology and Plant Pathology offer a joint undergraduate major in plant protection. See section on plant protection, pages 104-105 for details.

GRADUATE STUDY

The Department of Crop Science offers the degrees of Master of Agriculture, Master of Science, Master of Agronomy and Doctor of Philosophy. Prospective applicants should consult the Graduate School Catalog.

DAIRY SCIENCE

(See animal science, pages 74-77.)

ECONOMICS

(Also see liberal arts.)

Patterson Hall

Professor W. D. TOUSSAINT, Head of the Department

TEACHING AND RESEARCH

Professors: A. J. BARTLEY, A. J. COUTU, D. M. HOOVER, L. A. IHNNEN, H. B. JAMES, P. R. JOHNSON, R. A. KING, J. G. MADDOX, B. M. OLSEN, J. A. SEAGRAVES, R. L. SIMMONS, T. D. WALLACE, J. C. WILLIAMSON, JR., T. W. WOOD; Research Professor: J. G. SUTHERLAND (USDA); Adjunct Professor: D. R. DIXON; Professor Emeritus: E. W. SWANSON; Associate Professors: D. S. BALL, J. S. CHAPPELL, W. M. CROSSWHITE, M. M. EL-KAMMASH, E. W. ERICKSON, R. M. FEARN, C. W. HARRELL, JR., E. W. JONES, C. H. LITTLE, F. A. MANGUM, G. A. MATHIA, E. C. PASOUR, JR., R. J. PEELER, JR., R. A. SCHRIMPER, R. E. SYLLA, C. B. TURNER, J. W. WILSON; Assistant Professors: J. B. BULLOCK, G. A. CARLSON, L. M. ENNIS, JR., B. L. GARDNER, H. C. GILLIAM, JR. (USDA), T. J. GRENNES, D. N. HYMAN, C. P. JONES, J. S. LAPP, J. C. MATTHEWS, JR., M. B. McELROY, D. F. NEUMAN, R. K. PERRIN, J. C. POINDEXTER, H. A. SANDMAN; Visiting Assistant Professor: R. L. TINNERMEIER; Assistant Professor Emeritus: O. G. THOMPSON; Instructors: J. D. ACKER, C. H. BAKER, A. M. BEALS, JR., R. B. MCBURNEY, JR., W. P. PINNA, R. C. REINOSO, LEAH J. SMITH, M. W. SMITH, R. H. WILLIAMSON, ANN D. WITTE; Special Lecturers: MORADA A. HUNT, R. J. SZAL; Research Assistant: F. V. HARRELL, JR.

EXTENSION

Professor C. R. PUGH, In Charge of Farm Management and Public Affairs

Professors: W. L. TURNER, C. R. WEATHERS; Associate Professors: J. G. ALLGOOD, D. G. HARWOOD, H. L. LINER, R. C. WELLS; Assistant Professor: P. S. STONE; Instructor: D. C. PARDUE

Professor G. L. CAPEL, In Charge of Marketing Economics

Professors: T. E. NICHOLS, JR., E. A. PROCTOR; Associate Professors: R. S. BOAL, R. C. BROOKS, L. H. HAMMOND, H. A. HOMME; Assistant Professors: J. E. IKERD, E. M. STALLINGS, RUBY P. UZZLE

Agricultural economics is one of several fields of specialization offered by the Department of Economics. The department is administered jointly by the School of Agriculture and Life Sciences and the School of Liberal Arts. For information on fields of economics other than agricultural see pages 193 to 195 under the School of Liberal Arts.

The Bachelor of Science degree is offered for undergraduates. Students are given training in all aspects of organizing and operating agricultural business firms. A sound foundation in basic economic principles of production and marketing is provided in order that graduates will be able to deal with the problems associated with rapid changes in technical and economic conditions.

The general objectives of the department, in the area of agricultural economics, are as follows: (1) To train students in the fundamentals of business organization and to make sound decisions in organizing and managing farms and other agricultural businesses; (2) To instruct students in economic theory which may be used as a basis for understanding the relationship of agriculture to other parts of the economy and for the evaluation of agricultural policy and economic changes which affect agriculture; (3) To train graduate students in advanced economic theory and research techniques.

OPPORTUNITIES

Training in agricultural economics qualifies a student for a wide range of opportunities. The growing number of companies processing and manufacturing agricultural products has created an increasing demand for people trained in agricultural economics. Opportunities include employment by companies handling farm supplies, such as feed, fertilizer and equipment; general marketing and processing firms; agricultural cooperatives; professional farm management agencies, and various credit agencies.

Many graduates of the department are also employed in research and educational work by various agencies of the Federal and state governments. These include the Agricultural Extension Service, the Agricultural Experiment Station, the State Department of Agriculture and other agencies of the United States Department of Agriculture.

Openings in all of these areas greatly exceed the number of graduates trained to fill them. As industrial and agricultural development continues in North Carolina and other areas, employment opportunities are expected to increase.

UNDERGRADUATE CURRICULA

Two options are available to undergraduate students majoring in agricultural economics. These curricula options include business and science. Students must meet all of the basic requirements of the University and the School of Agriculture and Life Sciences.

Agricultural science majors are required to meet the science requirements presented on page 70. The student takes MA 212 to provide a stronger base for the quantitative areas of economics and techniques used in economic analysis. He is also required to strengthen his abilities in general areas of economics and business by fulfilling the departmental and Group B requirements and restricted electives of the business curriculum (except for courses in Personnel and Business Management).

In the business program in economics, students receive strong training in economics and business to develop the ability to identify, understand, and solve economic problems. The requirements of this program are outlined below.

AGRICULTURAL ECONOMICS

BUSINESS PROGRAM

	<i>Credits</i>
ALS 103 Orientation	1
<i>Languages</i> (12 Credits)	
ENG 111 Composition and Rhetoric	3
ENG 112 Composition and Reading	3
SP 231 Expository Speaking	3
Elective (English or Modern Language)	3
<i>Social Sciences and Humanities</i> (21 Credits)	
EC 205 Economic Activity	3
EC 212 Economics of Agriculture	3
HI 105 Modern Western World	3
PS 201 The American Governmental System	3
PSY 200 Introduction to Psychology	3
SOC 202 Principles of Sociology	3
Elective from Group D*	3
<i>Physical and Biological Sciences</i> (24-25 Credits)	
BS 100 General Biology	4
Biological Science Elective	4
CH 101 General Chemistry I	4
MA 111 Algebra and Trigonometry	4
MA 112 Analytic Geometry and Calculus A	4
or	
MA 114 Topics in Modern Math	3
PY 221 College Physics	5
<i>Departmental Requirements and Electives</i> (26 credits)	
EC 301 Production and Prices	3
EC 302 National Income and Economic Welfare	3
EC 317 Introduction to Methods of Economic Analysis	3
or	
ST 311 Introduction to Statistics	3
EC 413 Competition, Monopoly, and Public Policy	3
or	
EC 533 Agricultural Policy	3
Electives in Support of Major	14

<i>Electives and Restricted Electives</i> <i>from Groups A, B, and C*</i> (29 or 30 credits)	
Electives from Groups A and C	5 or 6
Group B—Requirements, Restricted	
Electives, and Electives	24
EC 312 Accounting I	3
Business Electives—Group B	6
Business Management:	
EC 310 Economics of the Firm	3
or	
EC 525 Management Policy and Decision Making	
Finance:	
EC 402 Financial Institutions	3
or	
EC 415 Farm Appraisal	
or	
EC 420 Corporation Finance	
Marketing:	
EC 311 Agricultural Markets	3
or	
EC 411 Marketing Methods	
or	
EC 521 Markets and Trade	
Personnel:	
EC 426 Personnel Management	3
or	
EC 431 Labor Economics	
or	
EC 432 Industrial Relations	
Production:	
EC 303 Farm Management	3
or	
EC 425 Industrial Management	
or	
EC 551 Agricultural Production Economics	
<i>Other Electives</i> (12 credits)	
Free Electives	12
Subtotal	126
Physical Education	4
Total Hours—130**	

* Group A includes the physical and biological sciences; Group B, economics and business management; Group C, applied science and technology; Group D, social sciences and humanities.
 ** This curriculum (and the Science curriculum) requires the completion of one course in literature.

A typical business program in economics is listed below. However, it should be emphasized that there is a great deal of flexibility in the agricultural economics major. Approximately 25 percent of the student's total course work is selected by the student in consultation with his major adviser. This flexibility permits each student to develop a strong background in business and economics and at the same time concentrate in a supporting area of major interest such as conservation, crops and soils, economic development, livestock and poultry, or processing of agricultural products. It also facilitates the fulfilling of the requirements for a major in other departments at the same time the degree in agricultural economics is being earned.

For the freshman year see page 69.

TYPICAL CURRICULUM IN AGRICULTURAL ECONOMICS BUSINESS PROGRAM

SOPHOMORE YEAR

	<i>Credits</i>
ANS 204 Livestock Feeds and Feeding	3
CS 211 Crop Science	3
EC 205 Economic Activity	3
EC 212 Economics of Agriculture	3
GN 301 Genetics in Human Affairs	3
HS 201 Principles of Horticulture	3
PSY 200 Introduction to Psychology	3
PY 221 College Physics	5
SOC 202 Principles of Sociology	3
SP 231 Expository Speaking	3
Physical Education	2
	<hr/> 34

JUNIOR YEAR

	<i>Credits</i>
EC 301 Production and Prices	3
EC 302 National Income and Economic Welfare	3
EC 303 Farm Management	3
EC 311 Agricultural Markets	3
EC 312 Accounting I	3
EC 415 Farm Appraisal and Finance	3
EC 431 Labor Economics	3
ENG 265 American Literature I (Beginnings to 1850)	3
ST 311 Introduction to Statistics	3
ZO 201 Animal Life	4
Free Elective	3
	<hr/> 34

SENIOR YEAR

	<i>Credits</i>
EC 407 Business Law I	3
EC 430 Agricultural Price Analysis	3
EC 440 Economic Development	3
EC 523 Planning Farm and Area Adjustments	3
EC 525 Management Policy and Decision Making	3
EC 533 Agricultural Policy	3
EC 551 Agricultural Production Economics	3
PHI 205 Problems and Types of Philosophy	3
Free Electives	7
	<hr/> 31
Total Hours—130	

GRADUATE STUDY

The Master of Economics, Master of Arts in economics and Master of Science in agricultural economics degrees are available as well as the Doctor of Philosophy degree with a specialization in agricultural economics. Prospective applicants should consult the Graduate School Catalog.

ENTOMOLOGY

Gardner Hall

Professor KENNETH L. KNIGHT, *Head of the Department*

TEACHING AND RESEARCH

Professors: R. C. AXTELL, C. H. BRETT, W. V. CAMPBELL, F. E. GUTHRIE, E. HODGSON, W. J. MISTRIC, JR., H. H. NEUNZIG, R. L. RABB, T. J. SHEETS, C. F. SMITH, D. A. YOUNG, JR.; *Adjunct Professors:* LOUISE M. RUSSELL, C. W. SABROSKY, R. I. SAILER, D. L. WRAY, JR.; *Professor Emeritus:* T. B. MITCHELL; *Associate Professors:* W. C. DAUTERMAN, M. H. FARRIER, H. B. MOORE, G. C. ROCK, C. G. WRIGHT, R. T. YAMAMOTO; *Adjunct Associate Professors:* A. L. CHASSON, E. W. CLARK; *Assistant Professors:* J. R. BRADLEY, JR., W. M. BROOKS

EXTENSION

Associate Professor: G. T. WEEKMAN, Specialist in Charge

Professor: R. L. ROBERTSON; Professor Emeritus: G. D. JONES; Associate Professors: R. M. FALTER, H. E. SCOTT; Assistant Professor: K. A. SORENSEN; Associate Member of the Faculty: F. E. WHITFIELD (Forestry)

The entomology curriculum offers broad training at both the undergraduate and graduate levels in basic biology and related sciences, particularly as they relate to the study of insects. In addition, introductory and terminal courses in insect control technology are offered at the undergraduate level for students majoring in other areas.

OPPORTUNITIES

Opportunities for careers in entomology are plentiful and varied. Research positions are available in many universities and colleges as well as with federal and state government and private industry. The needs for college teachers are also great. Other opportunities include development, production, control and sales positions in the pesticide field and regulatory and extension positions with state and federal agencies.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in entomology is offered under the science curriculum of the School of Agriculture and Life Sciences. Students are also encouraged to major in biological sciences and devote their electives to entomology courses.

For the freshman year and basic requirements see pages 69-74.

CURRICULUM IN ENTOMOLOGY

SCIENCE PROGRAM

Group A Courses (25-26 Credits)

BCH 351 Elementary Biochemistry or Equivalent	3
BO 421 Plant Physiology or	
ZO 421 Vert. Physiology	4
GN 411 The Principles of Genetics	3
GY 120 Physical Geology or	3
SSC 200 Soils	4
MB 401, 402 General Microbiology and Lab	4
ST 311 Intro. to Stat.	3
Electives*	5

* May be taken from Groups B and C.

Departmental Requirements and Electives (26 Credits)

ENT 301 Intro. to Forest Insects or	
ENT 312 Intro. to Econ. Insects	3
ENT 401 (ZO 401) Bib. Res. in Biology	1
ENT 502 Insect Diversity	4
ENT 503 Functional Systems of Insects	4
Advised Electives	14
Total Hours—130	

TYPICAL CURRICULUM IN ENTOMOLOGY

For the freshman year see page 69.

SOPHOMORE YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
CH 101 Gen. Chem. I	4	CH 103 Gen. Chem. II	4
Literature Elective	3	or	
Group D Elective	3	CH 107 Prin. of Chem.	4
GY 120 Physical Geology	3	English or Modern Language Elec.	3
or		ENT 312 Intro. to Econ. Insects	3
SSC 200 Soils	4	Group D Elective	3
Advised Elective	3	Free Elective	3
Physical Education	1	Physical Education	1
	17-18		17

JUNIOR YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
CH 220 Intr. Organic Chem.	4	BCH 351 Elementary Biochem.	3
PY 221 College Physics	5	GN 411 The Principles of Genetics	3
ZO 421 Vertebrate Physiol.	4	ST 311 Intr. to Statistics	3
Group D Elective	3	Group D Elective	3
	<hr/> 16	Free Elective	3
			<hr/> 15

SENIOR YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
ENT 401 (ZO 401) Bibl. Res. Biolog.	1	ENT 503 Functional Systems	
ENT 502 Insect Diversity	4	of Insects	4
Group D Elective	3	MB 401 Gen. Microbiol.	4
Advised Electives	6	Advised Electives	6
Free Elective	3	Free Elective	3
	<hr/> 17		<hr/> 17

PLANT PROTECTION

The Departments of Crop Science, Entomology and Plant Pathology offer a joint major in plant protection. See section on plant protection, pages 104-105 for details.

GRADUATE STUDY

The Master of Science and Doctor of Philosophy degrees are offered in entomology. Prospective applicants should consult the Graduate School Catalog.

FOOD SCIENCE

Schaub Food Science Building

Professor W. M. ROBERTS, Head of the Department

TEACHING AND RESEARCH

Professors: L. W. AURAND, T. A. BELL (USDA), T. N. BLUMER, H. B. CRAIG, J. L. ETHELLES (USDA), M. W. HOOVER, A. E. PURCELL (USDA), M. L. SPECK, F. G. WARREN; *Professor Emeritus:* I. D. JONES; *Associate Professors:* H. P. FLEMING (USDA), D. D. HAMANN, V. A. JONES, H. E. SWAISGOOD, N. B. WEBB; *Assistant Professors:* H. R. BALL, JR., D. E. CARROLL, JR., R. S. DAHIYA, S. E. GILLILAND, A. P. HANSEN, B. R. JOHNSON, W. M. WALTER (USDA); *Adjunct Assistant Professor:* W. Y. COBB

EXTENSION

Professors: J. A. CHRISTIAN, ELOISE COFER, M. E. GREGORY, F. B. THOMAS; *Associate Professors:* N. C. MILLER, JR., F. R. TARVER, JR.; *Assistant Professor:* MARY S. HEAD; *Specialists:* R. E. CARAWAN, S. J. STOKES

The Department of Food Science provides undergraduate and graduate programs for the application and coordination of the physical and biological sciences, economics and engineering to the development, processing, packaging, quality control, distribution and utilization of foods.

The department maintains modern and fully equipped laboratories for teaching and research programs in food microbiology and fermentation, food chemistry, food engineering and dairy, fruit, meat, poultry, seafood and vegetable products.

OPPORTUNITIES

The increasing consumer demands for greater varieties and quantities of highly nutritious and convenience foods of uniformly high quality create many and varied career opportunities in the food and allied industries for qualified personnel.

Specific career opportunities in the food industries are: management, research and development, process supervision, quality control, procurement, distribution, sales and merchandising. Career opportunities include sales and services in allied industries, consulting and trade association activities and promotional and educational services.

Food science graduates hold teaching, research and extension positions with colleges and universities. Many governmental agencies employ food scientists whose work is directed toward research, regulatory control and the development of food standards.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in food science is offered under the science or technology curriculum of the School of Agriculture and Life Sciences.

CURRICULA IN FOOD SCIENCE

SCIENCE OR TECHNOLOGY PROGRAM

Departmental Requirements and Electives (26 Credits)

FS 201 Food Science and Technology	3
FS 331 (BAE 331) Food Engineering	3
FS 402 Food Chemistry	3
FS 405 (MB 405) Food Microbiology	3
Departmental Electives	14

SCIENCE PROGRAM

SOPHOMOE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I		CH 223 Organic Chemistry II	
or		or	
CH 220 Introductory Organic Chemistry ...	4	CH 315 Quantitative Analysis	4
FS 201 Food Science and Technology	3	Literature Elective	3
MA 114 Topics in Modern Mathematics ...	3	MB 401 General Microbiology	4
PY 211 General Physics	4	PY 212 General Physics	4
Group D Elective	3	Physical Education	1
Physical Education	1		
	<u>18</u>		<u>16</u>

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
FS 331 (BAE 331) Food Engineering	3	Food Science Elective	3
FS 402 Food Chemistry	3	Group A Electives	6
FS 405 (MB 405) Food Microbiology	3	Group D Electives	6
Language Elective	3	Free Elective	3
Free Elective	3		
	<u>15</u>		<u>18</u>

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Food Science Electives	6	Food Science Electives	5
Group A Elective	2	Group A Elective	4
Group D Electives	6	Group D Elective	3
Free Elective	3	Free Elective	3
	<u>17</u>		<u>15</u>
		Total Hours—130	

TECHNOLOGY PROGRAM

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I		CH 223 Organic Chemistry II	
or		or	
CH 220 Introductory Organic Chemistry	4	CH 315 Quantitative Analysis	4
EC 205 Economic Activity	3	MB 401 General Microbiology	4
FS 201 Food Science and Technology	3	PY 221 College Physics	5
MA 114 Topics in Modern Mathematics	3	Literature Elective	3
PS 201 The American Governmental		Physical Education	1
System	3		
Physical Education	1		
	<hr/> 17		<hr/> 17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EC 212 Economics of Agriculture	3	Food Science Elective	3
FS 331 (BAE 331) Food Engineering	3	SOC 202 Principles of Sociology	3
FS 402 Food Chemistry	3	SP 231 Expository Speaking	3
FS 405 (MB 405) Food Microbiology	3	Group A, B, or C Electives	6
Free Elective	3	Free Elective	3
	<hr/> 15		<hr/> 18

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Food Science Electives	6	Food Science Electives	6
Group A, B, or C Elective	4	Group A, B, or C Electives	4
Group D Elective	3	Group D Elective	3
Free Elective	3	Free Elective	3
	<hr/> 16		<hr/> 16
		Total Hours—130	

GRADUATE STUDY

The Department of Food Science offers the Master of Food Science, Master of Science and Doctor of Philosophy degrees. Prospective applicants should consult the Graduate School Catalog.

GENETICS

Gardner Hall

Professor T. J. MANN, Head of the Department

Professors: C. H. BOSTIAN, D. S. GROSCH, W. D. HANSON, D. F. MATZINGER, L. E. METTLER, R. H. MOLL, T. MUKAI, L. C. SAYLOR, B. W. SMITH, S. G. STEPHENS, A. C. TRIANTAPHYLLOU; *Associate Professors:* L. G. BURK (USDA), W. E. KLOOS, C. S. LEVINGS, III, G. NAMKOONG (USFS), H. E. SCHAFER, C. W. STUBER; *Assistant Professor:* F. M. JOHNSON; *Instructor:* W. H. MCKENZIE; *Associate Members of the Faculty:* E. U. DILLARD, E. J. EISEN, J. E. LEGATES, O. W. ROBISON (Animal Science); F. B. ARMSTRONG (Biochemistry and Microbiology); D. H. TIMOTHY (Botany); C. A. BRIM, J. F. CHAPLIN, W. A. COPE, D. A. EMERY, D. U. GERSTEL, W. C. GREGORY, G. R. GWYNN, P. H. HARVEY, J. A. LEE, P. A. MILLER, C. F. MURPHY, L. L. PHILLIPS, C. F. TESTER (USDA), D. L. THOMPSON (USDA), E. A. WERNSMAN (Crop Science); C. C. COCKERHAM, M. M. GOODMAN, J. O. RAWLINGS (Statistics); J. W. DUFFIELD, T. O. PERRY, B. J. ZOBEL (Forestry); F. D. COCHRAN, G. J. GALLETTA, F. L. HAYNES, JR. (Horticultural Science); J. L. APPLE, T. T. HEBERT, N. T. POWELL (Plant Pathology); W. L. BLOW, E. W. GLAZENER, G. A. MARTIN (Poultry Science)

The genetics faculty offers instruction at advanced undergraduate and graduate levels. The undergraduate courses are designed to support the other departments of the institution, giving students a background in the science of genetics. The graduate program is designed to train scientists for research and teaching careers in basic genetics and in its application in plant and animal breeding.

UNDERGRADUATE CURRICULUM

The faculty does not have a program leading to the Bachelor of Science degree. Undergraduates are encouraged to pursue a program in the biological sciences.

GRADUATE STUDY

The Department of Genetics offers the Master of Science and the Doctor of Philosophy degrees. Prospective applicants should consult the Graduate School Catalog.

HORTICULTURAL SCIENCE

Kilgore Hall

Professor C. W. DONOHO, JR., Head of the Department

TEACHING AND RESEARCH

Professors: W. E. BALLINGER, F. D. COCHRAN, F. L. HAYNES, JR., L. J. KUSHMAN (USDA), R. A. LARSON, C. L. MCCOMBS, C. H. MILLER, D. T. POPE, R. L. SAWYER (Peru); *Visiting Professor:* DAMON BOYNTON (Peru); *Research Professor:* J. M. JENKINS, JR.; *Professors Emeriti:* M. E. GARDNER, G. O. RANDALL; *Associate Professors:* T. F. CANNON, F. E. CORRELL, G. J. GALLETTA, W. R. HENDERSON, T. R. KONSLEER, R. L. LOWER, P. V. NELSON; *Assistant Professors:* R. G. HALFACRE, L. K. HAMMETT, T. J. MONACO, W. B. NESBITT, C. R. UNRATH, D. C. ZEIGER; *Visiting Assistant Professors:* J. E. BRYAN, S. A. TUTEN (Peru); *Instructors:* R. M. SOUTHALL, V. H. UNDERWOOD; *Associate Members of the Faculty:* R. J. DOWNS (Botany); R. H. MOLL (Genetics); T. J. SHEETS (Entomology and Crop Science); R. AYCOCK (Plant Pathology); R. J. VOLK (Soils)

EXTENSION

Professor A. A. BANADYGA, In Charge

Professors: H. M. COVINGTON, M. H. KOLBE, J. W. LOVE; *Professor Emeritus:* J. H. HARRIS; *Associate Professors:* J. F. BROOKS, W. A. SKROCH; *Assistant Professors:* G. R. HUGHES, C. M. MAINLAND, W. W. REID, D. C. SANDERS, H. J. SMITH

The undergraduate programs in horticultural science offer broad training in the physical and biological sciences and business as well as a sound cultural background, to prepare students for graduate study or for diverse professional service in the fruit and vegetable crops field, in floriculture and in nursery management and landscape horticulture.

The varied climatic conditions in North Carolina make possible the production of a wide variety of horticultural crops on a commercial scale, as well as in parks and gardens. While these crops now represent an important segment of agriculture in North Carolina, further expansion will be realized with the development of adapted varieties, mechanization and intensification of cultural

practices, improvement of handling and marketing methods, and the development of the food processing industry.

OPPORTUNITIES

Graduates in horticulture will find numerous opportunities in a wide variety of positions in production, processing, sales and service. Among these are county extension agents; vocational agricultural teachers; landscaping and landscape contracting; farm operators; orchard, nursery, greenhouse and flower shop managers; research, production and promotional specialists with commercial seed, floral, fertilizer, chemical and food companies; inspectors and quality control technologists; USDA specialists and as leaders in other phases of agricultural and industrial developments. In addition, the student may prepare himself for one of the many opportunities for graduate study.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in horticultural science can be earned in one of the three curricula: business, science or technology, offered by the School of Agriculture and Life Sciences. Under these curricula, specialized training is offered for horticultural science majors in fruit and vegetable crops, and in floriculture, nursery management and landscape horticulture.

For the freshman year and basic requirements see pages 69-74.

For the business curriculum see page 70.

TYPICAL CURRICULA IN HORTICULTURAL SCIENCE SCIENCE PROGRAM

SOPHOMORE YEAR

	FV*	Credits OH*	F*
BO 200 Plant Life	4	4	4
CH 103 General Chemistry II	4	4	4
CH 220 Intro. Organic Chemistry	4	4	4
HS 211, 212 Ornamental Plants	—	6	6
HS 301 Plant Propagation	—	3	3
PY 221 College Physics	5	5	5
Social Sciences Elective	9	—	—
SSC 200 Soils	4	4	4
Elective	3	3	3
Physical Education	2	2	2
	35	35	35

* FV—Fruits and Vegetables

OH—Ornamental and Landscape Horticulture

F—Floriculture

JUNIOR YEAR

	FV*	Credits OH*	F*
BO 421 Plant Physiology	4	4	4
ENT 312 Intro. to Economic Insects	3	3	3
GN 411 The Principles of Genetics	3	3	3
GN 412 Elementary Genetics Lab	1	1	1
MB 401 General Microbiology	4	4	4
Modern Language or English Elective	6	6	6
PP 315 Plant Diseases	3	3	3
Social Sciences Elective	3	—	—
SSC 341 Soil Fertility and Fertilizers	—	3	3
Free Electives	6	6	6
	33	33	33

* FV—Fruits and Vegetables

OH—Ornamental and Landscape Horticulture

F—Floriculture

SENIOR YEAR

	FV*	Credits OH*	F*
HS 411 Nursery Management	—	3	—
HS 421 Fruit Production	3	—	—
HS 432 Vegetable Production	3	—	—
HS 441, 442 Floriculture I, II	—	—	6
HS 471 Arboriculture	—	3	—
HS 491 Senior Seminar	1	1	1
HS 562 (FS 562) Post-Harvest Physiology	3	—	—
Social Sciences Electives	3	15	15
Advised Electives	15	6	6
Free Electives	3	3	3
	31	31	31

* FV—Fruits and Vegetables
OH—Ornamental and Landscape Horticulture
F—Floriculture
Total Hours—130

TYPICAL CURRICULA IN HORTICULTURAL SCIENCE TECHNOLOGY PROGRAM

SOPHOMORE YEAR

	FV*	Credits OH*	F*
BO 200 Plant Life	4	4	4
CH 103 General Chemistry II	4	4	4
EC 205 Economic Activity	3	3	3
HS 211, 212 Ornamental Plants	—	6	6
HS 301 Plant Propagation	3	3	3
PY 221 College Physics	5	5	5
SP 231 Expository Speaking	3	3	3
Social Sciences Elective	6	—	—
SSC 200 Soils	4	4	4
Physical Education	2	2	2
	34	34	34

* FV—Fruits and Vegetables
OH—Ornamental and Landscape Horticulture
F—Floriculture

JUNIOR YEAR

	FV*	Credits OH*	F*
BO 421 Plant Physiology	4	4	4
EC 212 Economics of Agriculture	3	3	3
ENT 312 Intro. to Economic Insects	3	3	3
GN 411 The Principles of Genetics	3	3	3
GN 412 Elementary Genetics Lab	1	1	1
HS 414 Residential Landscaping	—	4	—
Modern Language or English Elective	3	—	3
PP 315 Plant Diseases	3	3	3
SOC 202 Principles of Sociology	3	3	3
SSC 341 Soil Fertility and Fertilizers	3	3	3
Free Elective	6	6	6
	32	33	32

* FV—Fruits and Vegetables
OH—Ornamental and Landscape Horticulture
F—Floriculture

SENIOR YEAR

	FV*	Credits OH*	F*
HS 411 Nursery Management	—	3	—
HS 421 Fruit Production	3	—	—
HS 432 Vegetable Production	3	—	—
HS 441, 442 Floriculture I, II	—	—	6
HS 471 Arboriculture	—	3	—
HS 491 Senior Seminar	1	1	1
HS 562 (FS 562) Post-Harvest Physiology	3	—	—
Modern Language or English Elective	—	3	—
Social Sciences Elective	—	6	6
Departmental Elective	14	8	11
Technical Elective	3	3	3
Free Elective	6	6	6
	33	33	33

Total Hours—130

* FV—Fruits and Vegetables
OH—Ornamental and Landscape Horticulture
F—Floriculture

GRADUATE STUDY

Graduate study under the direction of the horticultural science faculty may enable the student to qualify for the Master of Science or the Doctor of Philosophy degrees. Areas of study and research include plant physiology, plant breeding and genetics, post-harvest physiology, plant nutrition, growth regulators and weed science involving all horticultural crops. The professional degrees, Master of Horticulture and Master of Agriculture, can be earned by students who do not plan further graduate study and want to substitute additional course work for the research requirement in their graduate program. Cooperative Master of Science and Doctor of Philosophy degree programs can be arranged with the Departments of Botany, Food Science, Genetics and Soil Science. Prospective students should consult the Graduate School Catalog.

MEDICAL TECHNOLOGY

Gardner Hall

G. C. MILLER, *Major Adviser*

North Carolina State University has two parallel programs in medical technology. The first program consists of a four-year curriculum with a B.S. in zoology followed by a year of training in a hospital laboratory school.

The second program is designed to be completed in four calendar years. The student takes a prescribed curriculum for three years at North Carolina State University. The fourth year consists of a 12-month course in medical technology at the University of North Carolina at Chapel Hill. At the completion of this phase, a B.S. degree will be granted from North Carolina State University and a certificate in medical technology from the University of North Carolina at Chapel Hill. (See Department of Zoology pages 113-117.)

MICROBIOLOGY

Gardner Hall

Professor J. B. EVANS, Head of the Department

Professor: G. H. ELKAN; Associate Professors: W. J. DOBROGOSZ, P. B. HAMILTON, J. J. PERRY; Adjunct Associate Professor: J. J. TULIS; Assistant Professor: E. C. HAYES, III; Associate Members of the Faculty: J. G. LECCE, J. J. MCNEILL (Animal Science); F. B. ARMSTRONG (Biochemistry and Genetics); J. L. ETCHHELLS (USDA), M. L. SPECK (Food Science); W. E. KLOOS (Genetics); W. V. BARTHOLOMEW (Soil Science)

The program in microbiology is designed to provide basic preparation for professional microbiologists, a background in microbiology for students in the other biological sciences, and an awareness of the microbial world as it relates to our daily lives for students in the liberal arts and other areas outside the biological sciences.

Microbiology is concerned with the growth and development, physiology, classification, ecology, genetics and other aspects of the life processes of an array of tiny, generally single-celled, organisms. These organisms may serve as model systems for elucidation of fundamental processes that are common to all living cells. Most of the major discoveries that have produced the spectacular advances in biology during the past decade have resulted from studies of microbial systems. Future developments in the realm of environmental quality

and pollution control will rely heavily on an understanding of microbial processes of biodegradation and assimilation.

UNDERGRADUATE CURRICULUM

Although sufficient courses are offered to provide an undergraduate major, students with a primary interest in microbiology are advised to take the biological sciences curriculum (see pages 82-85) and to devote most of their electives to chemistry, mathematics and a foreign language. Generally no more than 12 credits in microbiology are recommended. However, if a student does not plan to go beyond the B.S. level, and desires to qualify for registration or a civil service position as a microbiologist, 20 credits in microbiology should be taken.

GRADUATE STUDY

The department offers programs leading to both the M.S. and the Ph.D. degrees in microbiology. Prospective applicants should consult the Graduate School Catalog.

PLANT PATHOLOGY

Gardner Hall

Professor D. E. ELLIS, Head of the Department

TEACHING AND RESEARCH

Professors: J. L. APPLE, R. AYCOCK, C. N. CLAYTON, E. B. COWLING, E. ECHANDI, T. T. HEBERT, C. S. HODGES, JR. (USDA), D. M. KLINE (USDA), G. B. LUCAS, L. W. NIELSEN, C. J. NUSBAUM, N. T. POWELL, J. P. ROSS (USDA), J. N. SASSER, R. T. SHERWOOD (USDA), D. L. STRIDER, H. H. TRIANTAPHYLLOU, N. N. WINSTEAD; Adjunct Professors: G. H. HEPTING, R. G. OWENS; Professor Emeritus: S. G. LEHMAN; Associate Professors: K. R. BARKER, G. V. GOODING, JR., D. HUISINGH, S. F. JENKINS, JR., R. D. MILHOLLAND, H. W. SPURR, JR. (USDA), R. E. WELTY (USDA); Adjunct Associate Professors: J. W. KOENIGS, E. G. KUHLMAN, R. A. REINERT; Associate Professor Emeritus: L. H. PERSON (USDA); Assistant Professors: M. K. BEUTE, L. F. GRAND, K. J. LEONARD (USDA), L. T. LUCAS, C. E. MAIN, C. G. VAN DYKE; Adjunct Assistant Professors: A. S. HEAGLE, R. W. PERO; Visiting Assistant Professor: E. R. FRENCH (Peru); Instructor: C. K. BATTEN; Associate Member of the Faculty: R. T. MOORE (Botany).

EXTENSION

Associate Professor H. E. DUNCAN, In Charge

Professors: F. A. TODD, J. C. WELLS; Professor Emeritus: H. R. GARRISS; Assistant Professors: C. W. AVERRE, III, R. K. JONES, P. B. SHOEMAKER

Undergraduate instruction in plant pathology is designed to provide introductory and advanced courses on the nature and control of plant diseases to students majoring in crop science, horticultural science, plant protection, agri-

cultural education and forestry, and to provide students with the fundamental training necessary for graduate study in plant pathology.

OPPORTUNITIES

Many opportunities for employment in research, extension and teaching are available to men with advanced degrees in the field of plant pathology. Openings are available for qualified men in research in the USDA, state experiment stations and in industry. The rapid development of agricultural chemicals and other methods for disease control offers numerous opportunities. See plant protection curriculum.

UNDERGRADUATE CURRICULUM

The Department of Plant Pathology cooperates in the training of plant protection majors, but does not offer a major in plant pathology at the undergraduate level.

GRADUATE STUDY

The Department of Plant Pathology offers graduate training in all phases of plant pathology leading to the degrees of Master of Science and Doctor of Philosophy.

PLANT PROTECTION

Williams and Gardner Halls

N. T. POWELL, *Major Adviser, Department of Plant Pathology*

D. A. EMERY, *Major Adviser, Department of Crop Science*

The major in plant protection is a joint major in the Departments of Entomology, Crop Science and Plant Pathology.

Students in plant protection will be trained in the application of chemical and biological principles for the control of plant diseases, insects and weeds. Crop losses from insects, weeds and diseases for the past several years have been estimated in excess of 10 billion dollars annually in the United States. A knowledge of the organisms to be controlled, the products to be used and the crops to be grown is basic to any control or regulatory program.

OPPORTUNITIES

Opportunities in plant protection basically involve improving farm efficiency to meet our ever-growing need for food and fiber. About 340 chemical companies are concerned with manufacturing and formulating products for pest control. Technically trained men are needed for sales development and promotion of agricultural chemicals. Graduates are also trained to fill positions as county extension agents or as state and federal regulatory agents. This major is primarily intended for the Bachelor of Science degree. However, qualified students can go on to graduate school from this curriculum.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in plant protection is offered

under the agricultural science curriculum of the School of Agriculture and Life Sciences.

For the freshman year and basic requirements see pages 69-74.

CURRICULUM IN PLANT PROTECTION

SCIENCE PROGRAM

<i>Restricted Electives from Group A (26 Credits)</i>	<i>Credits</i>	<i>Major Requirements (25 Credits)</i>	<i>Credits</i>
BO 421 Plant Physiology	4	BO 200 Plant Life	4
CH 220 and BCH 351 Introductory Organic Chemistry, Elementary Biochemistry	7	CS 211 Crop Science	3
or		CS 414 Weed Science	3
CH 221 and CH 223 Organic Chemistry I, Organic Chemistry II	8	ENT 312 Intro. to Economic Insects	3
GN 411 The Principles of Genetics	3	ENT 550 Fundamentals of Insect Control ..	3
MB 401 General Microbiology	4	PP 315 Plant Diseases	3
SSC 200 Soils	4	PP 500 Plant Disease Control	3
Electives from Group A, B or C	3 or 4	ZO 201 Animal Life	4
		Advised Electives	4
		Total Hours—130	

TYPICAL CURRICULUM IN PLANT PROTECTION

For the freshman year see page 69.

SOPHOMORE YEAR

<i>First Semester</i>	<i>Credits</i>	<i>Second Semester</i>	<i>Credits</i>
BO 200 Plant Life	4	CH 103 Gen. Chem. II	
CH 101 Gen Chem I		or	
or		CH 107 Prin. of Chem.	4
CH 105 Chem.—Prin. and Appl.	4	ENT 312 Intro. to Econ. Insects	3
CS 211 Crop Science	3	Mod. Language or English Elect.	3
Mod. Language or English Elect.	3	PY 221 College Physics	5
Social Science Elect.	3	Phys. Ed.	1
Phys. Ed.	1		<u>16</u>
	<u>18</u>		

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 220 Intro. Org. Chem.		BO 421 Plant Physiol.	4
or		BCH 351 Elem. Biochem.	3
CH 221 Organic Chem. I	4	or	
PP 315 Plant Diseases	3	CH 223 Organic Chem. II	4
SSC 200 Soils	4	GN 411 The Prin. of Genetics	3
Social Sciences Elect.	3	GN 412 Elem. Gen. Lab	1
Electives	3	Social Sciences Elect.	3
	<u>17</u>	Electives	3
			<u>17 or 18</u>

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CS 414 Weed Science	3	MB 401 Gen. Microbiology	4
ENT 551 Fund. of Insect Contr. Lab	2	PP 500 Plant Disease Cont.	3
Phys., Bio or Business or		Physical or Biol. Elective	2 or 3
Tech. Elect.	3	Social Sciences Elect.	3
Social Sciences Elect.	3	Elective	3
Elective	3		<u>15 or 16</u>
	<u>14</u>		

POULTRY SCIENCE

Scott Hall

Professor R. E. COOK, Head of the Department

TEACHING AND RESEARCH

Professors: H. L. BUMGARDNER, W. E. DONALDSON, E. W. GLAZENER, C. H. HILL; Professor Emeritus: C. W. BARBER; Associate Professors: W. L. BLOW, W. M. COLWELL, P. B. HAMILTON; Adjunct Associate Professors: J. B. WARD, T. B. DAMERON, JR.; Associate Professor Emeritus: F. W. COOK; Assistant Professors: L. G. ARENDS, D. M. BRIGGS, J. D. GARLICH, C. R. PARKHURST, W. R. PRINCE, D. G. SIMMONS, J. P. THAXTON; Visiting Assistant Professor: NANCY S. MUELLER

EXTENSION

Professor W. C. MILLS, JR., In Charge

Professors: W. G. ANDREWS, J. R. HARRIS; Professor Emeritus: C. F. PARRISH; Associate Professors: G. A. MARTIN, T. B. MORRIS; Assistant Professor Emeritus: C. J. MAUPIN; Instructor: J. R. WEST; Extension Specialist: C. E. BREWER

The Department of Poultry Science provides instruction in the principles of poultry husbandry and in such related fields as nutrition, physiology, genetics and pathology.

Through teaching, research and extension the department serves students, poultrymen and allied industries. The production of poultry has increased rapidly during the last two decades. Poultry products rank second in North Carolina as a source of agricultural income. North Carolina ranks fourth in the production of poultry products. The climatic and economic conditions in North Carolina provide a sound base for continued expansion of poultry enterprises.

OPPORTUNITIES

The change from small farm operations to large commercial poultry enterprises has created more specialized positions than are being filled by available poultry graduates. Off-the-farm operations in activities such as processing and distribution offer many new job opportunities. The allied industries providing such services as feed, equipment, financing and drugs need more employees each year who have been trained in poultry science. Graduates hold positions as managers and field representatives for numerous businesses identified with or serving the poultry industry. Graduates are also employed in the areas of communication and public relations and as teachers and extension and research specialists. A number of graduates have established their own successful poultry businesses.

UNDERGRADUATE CURRICULUM

Students desiring the Bachelor of Science degree with a major in poultry science may choose any of the three curricula offered by the School of Agriculture and Life Sciences. One may obtain a double major in certain other curricula through careful use of electives and/or summer school attendance. The student should consult the undergraduate advisers in the departments concerned.

For the freshman year and basic requirements see pages 69-74.

POULTRY SCIENCE CURRICULUM

BUSINESS PROGRAM

The curriculum may be selected by students desiring a background related to the operation and management of business firms on a sound economic basis. The general requirements for the business program are listed on page 70. In addition, there are 26 hours of departmental requirements. These requirements include the poultry courses listed in the science curriculum below. PO 524 (ZO 524) Comparative Endocrinology is not required. Additions are PO 301, Poultry Quality Evaluations and PO 402, Commercial Poultry Enterprises. CH 103, General Chemistry II, may be substituted for CH 107, Principles of Chemistry. Should this substitution be made, the student is required to take CH 220, Introductory Organic Chemistry instead of CH 221, Organic Chemistry I.

TYPICAL CURRICULUM IN POULTRY SCIENCE

SCIENCE PROGRAM

This curriculum is designed for the student who has an interest in the basic biological and physical sciences as greater emphasis is placed thereon. The student is better prepared for advanced study in various disciplines such as genetics, nutrition, physiology and pathology. Several preveterinary students are currently enrolled in the curriculum.

For the freshman year, see page 69.

SOPHOMORE YEAR

CH 101 General Chemistry I	4
CH 107 Principles of Chemistry	4
English Elective	3
PO 201 Poultry Production	4
PY 221 College Physics	5
or	
PY 211, 212 General Physics	8
Group D Electives	9
Physical Education	2

31 or 34

JUNIOR YEAR

CH 221 Organic Chemistry I	4
GN 411 The Principles of Genetics	3
MB 401 General Microbiology	4
ZO 421 Vertebrate Physiology	4
Group A Elective	4
Group B or C Elective	3
Group D Electives	6
Free Electives	6

34

SENIOR YEAR

PO 401 Poultry Diseases	4
PO 404 (FS 404) Poultry Products	3
PO 415 (ANS 415, NTR 415)	
Comparative Nutrition	3
PO 490 Poultry Seminars	2
PO 520 (GN 520) Poultry Breeding	3
PO 524 (ZO 524) Comparative	
Endocrinology	4
ZO 361 Vertebrate Embryology	4
Group A Elective (If PY 212 is	
not taken)	3
Group B or C Elective	3
Free Electives	6

31 or 35

Total Hours—130

TECHNOLOGY PROGRAM

The student desiring a more generalized program of study should select this curriculum which offers a greater selection of courses in the applied science and technology areas. The requirements for the sophomore and junior years are the same as for the science curriculum as modified by the changes noted in Group A and departmental requirements for the business curriculum. The Group D courses required are indicated on pages 73-74.

SENIOR YEAR

PO 401 Poultry Diseases	4
PO 404 (FS 404) Poultry Products	3
PO 415 (ANS 415, NTR 415) Comparative Nutrition	3
PO 490 Poultry Seminars	2
PO 520 (GN 520) Poultry Breeding	3
SSC 200 Soils	4
Group A, B or C Electives	6 or 10
Free Electives	6
<hr/>	
31 or 35	

Total Hours—130

GRADUATE STUDY

The Department of Poultry Science offers the Master of Science degree in poultry science and doctoral programs in physiology, genetics and nutrition. Prospective applicants should consult the Graduate School Catalog.

PREMEDICAL SCIENCES

Gardner Hall

Premedical, predental and preveterinary curricula are offered in the School of Agriculture and Life Sciences. Requirements for all the premedical sciences are very similar. Requirements may be met either through the science curriculum or the biological sciences curriculum. A number of students are accepted each year in leading medical colleges; several have received outstanding scholarships.

For further details on the preveterinary curriculum, see the following section.

For the premedical and predental details, see the Department of Zoology, pages 113-117, and the biological sciences curriculum, pages 82-85.

PREVETERINARY

Animal Disease Laboratory

Scott and Patterson Halls

E. G. BATTE, *Adviser, Animal Science*

J. R. HARRIS, *Adviser, Poultry Science*

D. J. MONCOL, *Adviser, Animal Science*

W. M. COLWELL, *Adviser, Poultry Science*

E. W. GLAZENER, *Secretary, N. C. Veterinary Selection Committee*

A preveterinary curriculum is offered as part of the North Carolina Veterinary Program. After the completion of the prescribed program North Carolina students are nominated to attend Colleges of Veterinary Medicine at the University of Georgia, Oklahoma State University and Tuskegee Institute. Arrangements are made for these students to attend at in-state rather than out-of-state rates.

If three years are spent in the preveterinary curriculum, some course credits may be transferred from the veterinary program toward the completion of a Bachelor of Science degree from North Carolina State University with a major in animal science, poultry science or zoology. Arrangements for this procedure are made prior to entrance into the veterinary school.

CURRICULUM

The preveterinary program is offered under the science curriculum of the School of Agriculture and Life Sciences.

PREVETERINARY CURRICULUM

SCIENCE PROGRAM

The courses listed below are minimum requirements for all students applying for entrance to veterinary school under the Southern Regional Educational Board contract. Only those students who complete the required courses successfully (grade C or better on each) will be considered eligible to apply. A 2.5 grade-point average on required courses is the minimum that the North Carolina Veterinary Selection Committee will recommend for attending any veterinary school.

<i>Language (9 Credits)</i>		CH 221 Organic Chemistry I	4
ENG 111 Composition and Rhetoric	3	CH 223 Organic Chemistry II	4
ENG 112 Composition and Reading	3	GN 411 The Principles of Genetics	3
English Elective	3	MA 111 Algebra and Trigonometry	4
<i>Social Sciences and Humanities (6 Credits)</i>		MA 112 Analytic Geometry and Calculus A	4
HI 105 Modern Western World	3	PY 211, 212 General Physics	8
PS 201 The American Governmental System	3	or PY 221 College Physics	5
<i>Physical and Biological Sciences (40-43 Credits)</i>		ZO 223 Comparative Anatomy	4
BS 100 General Biology	4	<i>Applied Science and Technology (11 Credits)</i>	
CH 101 General Chemistry I	4	ANS 200 Introduction to Animal Science	4
CH 107 Principles of Chemistry	4	ANS 204 Livestock Feeds and Feeding	3
		PO 201 Poultry Production	4

SOCIOLOGY AND ANTHROPOLOGY

(Also see liberal arts.)

1911 Building

Professor S. C. MAYO, Head of the Department

TEACHING AND RESEARCH

Professors: C. H. HAMILTON, C. P. MARSH, G. C. McCANN, J. N. YOUNG;
Associate Professors: H. G. BEARD, A. C. DAVIS, L. W. DRABICK, C. V. MERCER, H. D. RAWLS, M. M. SAWHNEY, ODELL UZZELL; *Visiting Associate Professor:* H. D. HOLDER; *Adjunct Associate Professors:* W. J. BUFFALOE, R. L. ROLLINS, JR.; *Assistant Professors:* R. C. BRISSON, T. E. CLARK, W. B. CLIFFORD, III, D. F. COLLINS, C. G. DAWSON, G. L. FAULKNER, T. M. HYMAN, R. L. MOXLEY, R. D. MUSTIAN, ELIZABETH M. SUVAL, PATRICIA L. TOBIN; *Visiting Research Assistant Professor:* IDONNA E. RUSSELL; *Instructors:* HELEN P. CLARKSON, G. S. NICKERSON, J. G. PECK, BETTY H. WISER; *Associate Members of the Faculty:* R. J. DOLAN (Adult Education); L. W. MONCRIEF (Recreation Resources Administration)

EXTENSION

Assistant Professor J. N. COLLINS, In Charge of Community Development

Professor: J. D. GEORGE; *Professor Emeritus:* J. W. CRAWFORD; *Assistant Professors:* T. N. HOBGOOD, JR., C. E. LEWIS, P. P. THOMPSON

The major aim of this department is to teach students the principles and techniques for understanding human group behavior. More specifically the department seeks: (1) to train students to become leaders in organizing groups and communities and in administering their programs; (2) to qualify exceptional students on the undergraduate and graduate levels for sociological research, teaching and extension work; (3) to solve problems in human group relations through scientific research and (4) to extend research results to the people of the State.

UNDERGRADUATE CURRICULUM

The degree of Bachelor of Science with a major in sociology is offered under the science curriculum of the School of Agriculture and Life Sciences.

CURRICULUM IN RURAL SOCIOLOGY

SCIENCE PROGRAM

For the freshman year and basic requirements see pages 69-74.

<i>Group A Courses (26 Credits)</i>		<i>Credits</i>	
GN 411 The Principles of Genetics			
or			
GN 301 Genetics in Human Affairs	3	SOC 202 Principles of Sociology	3
GY 120 Physical Geology	3	SOC 301 Human Behavior	3
ST 311 Intro. to Statistics	3	SOC 341 Rural Society—U.S.A.	3
Electives*	17	SOC 342 Rural Societies Around the World	3
<i>Departmental Requirements and Electives (26 credits)</i>		SOC 411 Community Relationships	3
ANT 252 Cultural Anthropology	3	SOC 416 Research Methods	3
		Electives	3
		Total Hours—130	

* Six credits may be elected from Groups B and C. Additional electives from Group D.

GRADUATE STUDY

The Master of Science, Master of Sociology and Doctor of Philosophy degrees are offered by this department. Prospective applicants should consult the Graduate School Catalog.

SOIL SCIENCE

Williams Hall

Extension Professor J. V. BAIRD, Acting Head of the Department

TEACHING AND RESEARCH

Professors: W. V. BARTHOLOMEW, S. W. BUOL, M. G. COOK, R. W. CUMMINGS, C. B. DAVEY, J. W. FITTS (AID), W. A. JACKSON, E. J. KAMPRATH, J. F. LUTZ, C. B. McCANTS, R. J. McCracken, R. J. VOLK, S. B. WEED, W. G. WOLTZ, W. W. WOODHOUSE, JR.; *Adjunct Professors:* L. J. METZ, J. M. SPAIN, *Associate Professors:* F. R. COX, G. A. CUMMINGS, R. B. DANIELS (USDA), J. W. GILLIAM, R. E. McCOLLUM, J. B. WEBER; *Adjunct Associate Professor:* CAROL G. WELLS; *Visiting Associate Professors:* A. H. HUNTER (AID), J. L. WALKER (AID), D. L. WAUGH (AID); *Associate Professors Emeriti:* W. D. LEE, A. MEHLICH, W. H. RANKIN; *Research Associate Professor Emeritus:* J. R. PILAND; *Assistant Professors:* D. W. EADDY, E. E. GAMBLE (USDA), C. K. MARTIN, P. A. SANCHEZ, E. D. SENECA, J. E. SHELTON, R. W.

SKAGGS, C. D. SOPHER; *Visiting Assistant Professor*: C. D. RAPER, JR.;
Instructors: C. P. BICKFORD, T. R. C. TONKINSON

EXTENSION

Professor G. L. JONES, *In Charge of Agronomy Extension*

Associate Professor: J. A. PHILLIPS; *Visiting Associate Professor*: J. F. DOGETT (AID); *Assistant Professor*: D. L. TERRY; *Instructor*: J. S. BARNES

The primary objectives of the Department of Soil Science are to train students in fundamentals of soils, develop in them an understanding and appreciation of soils as a resource, and present principles of soil management and utilization for both farm and nonagricultural purposes. Soils constitute one of the largest capital investments in farming and proper soil management is essential for efficient production. World food needs of the future will require people trained and conversant in soil resources and use of fertilizers. Nature and properties of the soils are important considerations in urban-suburban planning and development. Also, knowledge of soil and its interactions with potential pollutants are useful in conserving environmental quality. Therefore, the demand by educational, research, service, planning-development, conservation-related, and service agencies and agri-businesses for people trained in soils should continue to be great.

OPPORTUNITIES

Soil science graduates are trained to fill positions of leadership and service in many areas of agricultural, conservation and resource planning work. Among these are opportunities as farm operators and managers, county agricultural extension agents and employees of other public advisory agencies, Soil Conservation Service and other conservation-related agency representatives, employees of planning and health-related agencies concerned with soil resources, and as technical representatives and salesmen in fertilizer companies and other agri-businesses. Provision is made for those students wishing a more thorough training in biological sciences, chemistry, mathematics and physics leading to graduate study. Students with advanced degrees have wide opportunities in teaching, research, service and extension with state, federal and private educational and research institutions and agencies. Also, there are increasing opportunities in support of agribusiness.

UNDERGRADUATE CURRICULUM

The Bachelor of Science degree may be obtained in the Department of Soil Science under any of four curricula—business, science, technology or conservation. For the basic requirements and freshman year, see pages 69-74. The conservation curriculum is shown on pages 86-89.

CURRICULA IN SOIL SCIENCE

BUSINESS PROGRAM

This curriculum is designed for students desiring a background in business with a technical knowledge of soil science. The program requires the completion of courses in the technology curriculum and the business courses as outlined on pages 70-71.

SCIENCE PROGRAM

	<i>Credits</i>
<i>Physical and Biological Sciences</i>	
BO 200 Plant Life	4
<i>Group A Courses</i>	
BO 421 Plant Physiology	4
Chemistry Electives	8
MA 112, 212 Analytical Geometry and Calculus A, B	7
Group A Elective	4

	<i>Credits</i>
<i>Departmental Requirements and Electives</i>	
SSC 200 Soils	4
SSC 341 Soil Fertility and Fertilizers	3
SSC 452 Soil Classification	3
SSC 461 Soil and Water Conservation	3
SSC 462 Soil Management Systems	3
SSC 492 Senior Seminar	1
Departmental Electives	9

Total Hours—130

TYPICAL SOIL SCIENCE CURRICULUM

SOPHOMORE YEAR	
BO 200 Plant Life	4
CH 101 General Chemistry I	4
CH 107 Principles of Chemistry	4
MA 112, 212 Analytical Geometry and Calculus A, B	7
SP 231 Expository Speaking	3
SSC 200 Soils	4
Group D Elective	3
Physical Education	2
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JUNIOR YEAR	
CH 221 Organic Chemistry I	4
Chemistry Elective	4
English Elective	3
PY 211, 212 General Physics	8
SSC 341 Soil Fertility and Fertilizers	3
SSC 452 Soil Classification	3
Group D Electives	6
Free Electives	3
	<hr/> 34

SENIOR YEAR

BO 421 Plant Physiology	4
SSC 461 Soil and Water Conservation	3
SSC 462 Soil Management Systems	3
SSC 492 Senior Seminar	1
Departmental Electives	8
Group A Elective	3
Group D Electives	6
Free Electives	6
	<hr/> 34

Total Hours—130

CURRICULUM IN AGRONOMY*

TECHNOLOGY PROGRAM

	<i>Credits</i>
<i>Physical and Biological Sciences</i>	
BO 421 Plant Physiology	4
<i>Group A Courses (10 Credits)</i>	
CH 220 Introductory Organic Chemistry	4
GN 411 The Principles of Genetics	3
PP 315 Plant Diseases	3
<i>Group A, B, or C Courses (10 Credits)</i>	
Electives	10
<i>Departmental Requirements and Electives</i> (27 Credits)	
CS 211 Crop Science	3
CS 214 Crop Science Laboratory	1

	<i>Credits</i>
CS 312 Pastures & Forage Crops	3
CS 413 Plant Breeding	3
CS 414 Weed Science	3
SSC 341 Soil Fertility and Fertilizers	3
SSC 452 Soil Classification	3
SSC 461 Soil and Water Conservation	3
SSC 492 Senior Seminar	1
Electives	4

Total Hours—130

TYPICAL CURRICULUM

SOPHOMORE YEAR	
CH 101, 103 General Chemistry I, II	8
CS 211 Crop Science	3
CS 214 Crop Science Laboratory	1
EC 205 Economic Activity	3
EC 212 Economics of Agriculture	3
SP 231 Expository Speaking	3
SSC 200 Soils	4
Group D Elective	3
Group A, B, or C Elective	3
Physical Education	2
	<hr/> 33

JUNIOR YEAR	
BO 421 Plant Physiology	4
CH 220 Introduction to Organic Chemistry	4
CS 311 Field Crop Prod. or CS 312 Pastures & Forage Crops	3
PP 315 Plant Diseases	3
PY 221 College Physics	5
SOC 202 Principles of Sociology	3
SSC 341 Soil Fertility and Fertilizers	3
SSC 452 Soil Classification	3
Group D Elective	3
Free Elective	3
	<hr/> 34

SENIOR YEAR

CS 413 Plant Breeding	3
CS 414 Weed Science	3
GN 411 The Principles of Genetics	3
SSC 461 Soil and Water Conservation	3
SSC 462 Soil Management Systems	3
SSC 492 Senior Seminar	1
Group A, B, or C Elective	3
Free Electives	9
Departmental Elective	4

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* The Agronomy major is administered by the Departments of Crop Science and Soil Science and is listed under both departments.

GRADUATE STUDY

The Department of Soil Science offers programs leading to the degrees of Master of Science and Doctor of Philosophy. Prospective students should consult the Graduate School Catalog.

ZOOLOGY

Gardner Hall

Professor D. E. DAVIS, Head of the Department

Professors: F. S. BARKALOW, JR., R. HARKEMA, W. W. HASSLER, F. E. HESTER (USDI), B. S. MARTOF, G. C. MILLER, T. L. QUAY; *Adjunct Professors:* D. H. K. LEE (USDHEW), T. R. RICE (USDI), P. N. WITT (NCDMH); *Professor Emeritus:* B. B. BRANDT; *Associate Professors:* B. J. COPELAND, J. E. HOBBIE, C. F. LYTLE, J. F. ROBERTS, D. E. SMITH, A. M. STUART; *Adjunct Associate Professors:* J. W. ANGELOVIC (USDI), J. G. VANDENBERGH (NCDMH), R. B. WILLIAMS (USDI), D. A. WOLFE (USDI); *Assistant Professors:* PHYLLIS C. BRADBURY, NANCY S. MUELLER, W. F. STANDAERT; *Adjunct Assistant Professors:* F. A. CROSS (USDI), T. A. LINTON (NCDCH), B. D. NELSON (USDHEW); *Associate Members of the Faculty:* D. S. GROSCH, L. E. METTLER (Genetics); D. W. HAYNE (Statistics)

The Department of Zoology provides undergraduate and graduate instruction in many specialized areas of the biological sciences. Undergraduates study all levels of biological organization from the molecular to the community. Students majoring in the department are adequately prepared for graduate work in zoology and related fields of science. Participation in supervised programs of research is strongly encouraged. Basic training is also available for students planning to enter dentistry, medicine and veterinary medicine and allied health sciences.

OPPORTUNITIES

Students may choose to continue their study with graduate work leading to the Master of Science and Doctor of Philosophy degrees in zoology and wildlife. However, numerous employment opportunities are available. Majors are qualified for many positions in the medical sciences, various government agencies and private industries.

UNDERGRADUATE CURRICULA

The Bachelor of Science degree with a major in zoology or wildlife biology

is offered under the science curriculum of the School of Agriculture and Life Sciences. Students selecting premedical or predental option receive a degree in zoology.

The requirements for admission to medical and dental schools vary slightly from those given below in the zoology curriculum. For specific requirements consult the catalog of those schools where you plan to apply for admission. Students majoring in fisheries can meet the requirements of either the zoology curriculum or the wildlife biology curriculum. In cooperation with Rex Hospital, a nursing program is available. The program for the freshman year is listed on page 69. The other basic requirements are listed in the science curriculum on page 70.

The sophomore year will normally include ZO 201, Animal Life; ZO 223, Comparative Anatomy or ZO 351, Vertebrate Zoology; CH 221, Organic Chemistry I, and either CH 223, Organic Chemistry II, or BCH 351, Elementary Biochemistry.

After completion of these courses the student may specialize in several areas depending upon his interest and ability. The zoology sequence prepares students for graduate school.

REQUIRED COURSES IN ALL CURRICULA IN ZOOLOGY

	<i>Credits</i>		<i>Credits</i>
CH 221 Organic Chemistry I	4	ZO 223 Comparative Anatomy	4
CH 223 Organic Chemistry II	4	or	
or		ZO 351 Vertebrate Zoology	4
BCH 351 Elementary Biochemistry	3	ZO 414 (BO 414) Cell Biology	4
ZO 201 Animal Life	4	or	
		ZO 421 Vertebrate Physiology	4

Other requirements for specific curricula include:

Zoology

GN 411 Principles of Genetics	3
One year of general physics	8
Advised electives*	29

Fishery Biology and Wildlife Biology

PY 221 College Physics	5	ZO 441 Ichthyology	3
or		or	
PY 211, 212 General Physics	8	ZO 553 Prin. of Wildlife Science	5
ZO 221 Conserv. of Nat. Res.	3	ZO 360 (BO 360) Intro. to Ecology	4
ZO 420 Fishery Science	3	Advised Electives**	18 to 23

* Three courses in zoology, one of which must be ZO 360 or ZO 361.

** Must include one course in botany and one in entomology.

TYPICAL CURRICULUM IN ZOOLOGY

SCIENCE PROGRAM

For the freshman year, see page

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chem. I	4	BCH 351 Elem. Biochem.	3
Language Elective*	3	or	
Soc. Sci. Elective	6	CH 223 Organ. Chem. II	4
ZO 201 Animal Life	4	Language Elective	3
Physical Eduaction	1	Soc. Sci. Elective	3
	18	ZO 223 Comp. Anatomy***	4
		or	
		ZO 351 Vertebrate Zool.	1
		Physical Education	

14 or 15

* Modern foreign language is recommended.

*** Wildlife majors may take ZO 350 or ZO 351; see senior year below.

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
GN 411 The Prin. of Genetics	3	PY 212 General Physics	4
GN 412 Elem. Genetics Lab.	1	Soc. Sci. Elective	3
PY 211 General Physics	4	ZO 361 Vert. Embryology**	4
Soc. Sci. Elective	3	ZO 350 Invert. Zoology	4
Advised Elective	4	Elective	3
	<u>15</u>		<u>18</u>

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Soc. Sci. Elective	3	Soc. Sci. Elective	3
ZO 360 (BO 360) Intro. to Ecol.** ..	4	ZO 590 Special Studies	2
ZO 414 (BO 414) Cell Biol.	4	Advised Electives	11
or			<u>16</u>
ZO 421 Vert. Physiology	6		
Electives	<u>6</u>		
	<u>17</u>		

Total Hours—130

** All students must take either ZO 360 or ZO 361 or both.

TYPICAL CURRICULUM IN WILDLIFE BIOLOGY

SCIENCE PROGRAM

For the freshman year see page 69.

For the sophomore year, see the typical curriculum in zoology, above.

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 200 Plant Life	4	Botany Elective	4
PY 221 College Physics	5	Entomology	3
Soc. Sci. Electives	6	Soc. Sci. Electives	6
ZO 221 Cons. of Nat. Res.	3	ZO 351 Vert. Zoology	4
	<u>18</u>		<u>17</u>

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ZO 360 (BO 360) Intro. to Ecology ..	4	GN 411 The Prin. of Gen.	4
ZO 420 Fishery Science	3	ST 311 Intro. to Statistics	3
ZO 421 Vert. Physiol.	3	ZO 350 Invert. Zoology	4
ZO 553 Prin. Wildlife Sci.	5	Electives	4
Electives	<u>3</u>		<u>15</u>
	<u>16</u>		

Total Hours—130

TYPICAL CURRICULUM IN MEDICAL TECHNOLOGY

SCIENCE PROGRAM

Two programs are available in medical technology. The first is a four-year collegiate curriculum with a Bachelor of Science degree in zoology (see above) followed by a year of training in any hospital clinical laboratory approved by the American Medical Association. The second program is designed to be completed in four calendar years. The student takes the prescribed curriculum for three years at N. C. State University and a fourth year (12 months) of clinical training at the N. C. Memorial Hospital at Chapel Hill. Successful completion of this program qualifies the student for a Bachelor of Science degree in medical technology from North Carolina State University. Acceptance by the clinical laboratory is competitive and students in either program outlined above must apply for clinical training. After completion of either program the

student is eligible to take the national examination of the Board of Registry of Medical Technologists.

For the freshman year see page 69.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 315 Quantitative Analysis	4	Language or English Elective	3
Language or English Elective	3	MB 401 General Microbiology	4
PS 201 The American Gov't System	3	PY 221 College Physics	5
ZO 201 Animal Life	4	Social Science or Humanity	3
Elective	3	Physical Education	1
Physical Education	1		
	18		16

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I	4	CH 223 Organic Chemistry II	4
Social Science or Humanity	6	Social Science or Humanity	6
ZO 421 Vertebrate Physiology	4	ZO 223 Comparative Anatomy	4
or		Elective	3
ZO 414 (BO 414) Cell Biology	4		
Elective	4		17
	18		

Total Hours—100

SENIOR YEAR

A 12-month course in medical technology to be taken at an associated Hospital Clinical Laboratory.

	<i>Hours</i>
Bacteriology and Parasitology	8.0
Serology	3.5
Biochemistry (clinical chemistry)	9.0
Basal Metabolism and	
Electrocardiography	1.0
Tissue Technique	3.5
Clinical Microscopy	4.0
Hematology (Including Coagulation)	6.5
Blood Bank	3.5
Ethics & Laboratory Management	1.0
	Total 40.0

For curricula in conservation see pages 86-89.

OPTIONS IN ZOOLOGY CURRICULUM

Students desiring to emphasize certain areas within zoology may choose an option:

PREMEDICAL OR PREDENTAL OPTION IN ZOOLOGY

SCIENCE PROGRAM

<i>Departmental Requirements</i>	
General Physics	3
Comparative Anatomy	4
Organic Chemistry I, II	8
Quantitative Analysis	4
Genetics	4
Physiology	4-8
Embryology	3
Modern foreign language	6
	Total Hours—130

FISHERIES OPTION IN ZOOLOGY

SCIENCE PROGRAM

<i>Departmental Requirements</i>	
Physiology	4
Limnology	4
Ecology	4
Ichthyology	4
Fishery Science	3
Economic Insects	3
Advised Electives	4
	Total Hours—130

GRADUATE STUDY

The Department of Zoology offers to qualified students the opportunity to earn the Master of Science and the Doctor of Philosophy degrees. Prospective applicants should consult the Graduate School Catalog.

AGRICULTURAL EXPERIMENT STATION

E. W. GLAZENER, *Acting Dean of Agriculture and Life Sciences*

J. C. WILLIAMSON, JR., *Director of Research*

The Agricultural Experiment Station was established in accordance with an act of the General Assembly of 1877 and amended in 1955. The North Carolina General Assembly has allocated to the station, annually, certain funds from the general fund.

The purpose of the Agricultural Experiment Station is to study the basic laws of nature underlying agricultural enterprises and to develop methods for economic production of the highest grades of livestock, poultry and plants on the many soil types and under the varied conditions existing in North Carolina; to study methods for the control of parasitic insects and organisms that cause serious economic losses of animals, poultry and plants; to find and develop new varieties of animals, poultry and plants resistant to diseases and insects and tolerant of the variable conditions prevailing in the State, and to perfect better marketing for all agricultural products.

The staff of the experiment station conducts experiments in the greenhouse and laboratories of the University and throughout the State on 16 strategically located experimental farms and on farms rented for short periods.

The agricultural research aims are to improve the well-being of farmers through the discovery of new facts; to strengthen the regulatory work of the State Department of Agriculture; to develop new and necessary facts for the teaching of sound agricultural principles by vocational agricultural instructors, agricultural extension agents and agricultural instructors in the University.

The Agricultural Experiment Station staff brings to the University many experts, whose teaching in many specialized fields of agriculture assures the maintenance of curricula of high standards. It contributes much to the advanced training of students who are destined to become the leaders, teachers and investigators necessary in the maintenance of agriculture on sound and economic planes.

PUBLICATIONS

The Agricultural Experiment Station publishes many bulletins and scientific papers on results of research conducted by the staff. These are free and are sent upon request to anyone in the State.

SERVICES

The staff diagnoses and interprets many problems for the farmers of North Carolina. It holds council with farmers and others interested in the agricultural industry, presents radio programs devoted to the discussion of farming procedures, and writes many letters on more specific problems of agriculture at the request of farmers, members of garden clubs, and manufacturers of fertilizer, fungicides and insecticides. It also takes part in many of the administrative functions of the University.

AGRICULTURAL EXTENSION SERVICE

E. W. GLAZENER, *Acting Dean of the School of Agriculture and Life Sciences*

GEORGE HYATT, JR., *Director of the Agricultural Extension Service*

The Agricultural Extension Service of North Carolina State University is a cooperative undertaking between the U. S. Department of Agriculture, the State of North Carolina and the 100 counties in the State. Its work is supported by federal funds made available under the Smith-Lever Act of 1914, as amended, and by state and county appropriations.

The federal and state appropriations are used to maintain an administrative and specialist staff and to pay a portion of the salary and the travel expenses of the county extension agents. Under this cooperative arrangement, the Agricultural Extension Service serves as the "educational arm" of the U. S. Department of Agriculture, and as the "field faculty" of North Carolina State University in the areas of agriculture, production and marketing, family living, 4-H and youth, community resource development and natural resource development.

OBJECTIVES

The primary purpose of the North Carolina Agricultural Extension Service is to take to the people of the State the latest and best information obtainable, particularly that which is related to agriculture and home economics, and help them to interpret and use this information in building a more prosperous and satisfying life.

To accomplish this purpose, the institution maintains a staff of trained specialists in each of the major subject-matter areas. These specialists work primarily with and through the county agricultural and home economics agents in the conduct of a state-wide educational program.

This program has sufficient flexibility to permit special attention to the problems, needs and interests of the people in each of the individual counties. Educational assistance is given to individuals, families, industrial processing and marketing firms, other businesses and certain organizations. This includes work with both adult men and women and with boys and girls.

In carrying out this educational program, a variety of methods and techniques are employed: method and result demonstrations; meetings; visits to farms, homes and businesses; organized groups of men, women and youth; tours; leaflets, pamphlets and other printed materials, and mass media.

The basic source of information to be taught through this educational program is the findings and recommendations resulting from research conducted by the experiment stations in this and other states, and by the U. S. Department of Agriculture.

AGRICULTURAL INSTITUTE

Patterson Hall

EDWARD W. GLAZENER, *Acting Dean of Agriculture and Life Sciences and Director of Academic Affairs*

H. BRADFORD CRAIG, *Assistant Director of Academic Affairs and Director of the Agricultural Institute*

A two-year program in agriculture was approved and money was appropriated for this purpose by the 1959 General Assembly. Through action of the Board of

Trustees of the Consolidated University, this two-year program was named the North Carolina Agricultural Institute and was approved for operation on the North Carolina State University campus.

The major objective of the Agricultural Institute is to provide technical training to the individual so that he may become more productive in our agricultural society. Specifically, instruction offered by the Agricultural Institute is designed to train men and women for those jobs in agriculture and related occupations that require technicians with education beyond the high school level. An individual with this type of training should have a better income, assume a more prominent role of leadership, and become an asset to agriculture and to his community.

The institutional programs of the Agricultural Institute are organized and conducted as a part of the over-all resident instruction program for the School of Agriculture and Life Sciences. The institute is an addition to, and not a substitute for, the regular degree-granting program of the School of Agriculture and Life Sciences. However, in order to provide students enrolled in the institute with the best possible technical training, the faculty in residence for the four-year program is responsible for organizing and teaching courses offered by the institute.

People who have training similar to that which can be obtained in the courses offered in the Agricultural Institute are in great demand by agricultural industries. As this demand changes, courses of study will be evaluated and alterations made to keep abreast of the times. Through such a system the programs provided by the institute are aiding the technical manpower needs of agriculture in North Carolina.

OPPORTUNITIES FOR GRADUATES

Rapid technical advancement has been extremely important in changing agriculture from a small production industry to one of the largest industries in the nation. Today the farmer uses scientifically developed seed, feed and fertilizer, does most of his work with machinery, and has scientific testing to back up his management decisions. Increased production has allowed him to sell much of his production rather than just the surplus above home consumption. Farms have become larger due to these technological advances and large amounts of capital are needed to operate successfully. All of these factors bring about dependence on outside sources of information and capital for success in a modern agricultural business.

Not only the person who farms, but the hundreds of related businesses that are a vital part of agriculture today cannot operate successfully without men trained in technical skills.

ENTRANCE REQUIREMENTS

Any individual who has received a diploma from an accredited high school or has passed the high school equivalency examination administered by the State Department of Public Instruction is eligible for entry into the Agricultural Institute. Each application will be reviewed and evaluated by the institute director before an applicant will be accepted.

PROGRAM OF STUDY

The eight programs of study currently offered are: agricultural equipment technology, general agriculture, livestock management and technology, urban and industrial pest control, ornamental crops technology, field crops technology, soil technology and turfgrass management.

TYPE OF DEGREE AWARDED

Graduates of the Agricultural Institute are awarded the Associate in Applied Agriculture degree.

INSTITUTE OF BIOLOGICAL SCIENCES

Patterson Hall

EDWARD W. GLAZENER, *Dean of Agriculture and Life Sciences and Director of Academic Affairs*

J. C. WILLIAMSON, JR., *Director of Research*

J. L. APPLE, *Director of the Institute of Biological Sciences and Assistant Director of Research*

The Institute of Biological Sciences is an organizational unit of the School of Agriculture and Life Sciences comprising the Department of Biochemistry, Biological and Agricultural Engineering, Botany, Entomology, Genetics, Microbiology, Plant Pathology, Zoology, and the faculties of Biomathematics, Cell Biology and Physiology. The function of the institute is to promote excellence in the teaching and research programs of the biological science departments and to encourage and to coordinate interdepartmental and/or multidisciplinary instructional and research activities. The organizational structure provides a mechanism for the development and administration of multidisciplinary team-research and program-type grants which address broad complex problems. Such activities involve not only faculty from the biological science departments but those from the commodity-oriented departments within the School.

The interdepartmental instructional program includes the undergraduate biological sciences curriculum which prepares the student for graduate study in any of the biological fields or for a teaching career. (See pages 82-85.)

DESIGN

Brooks Hall

HENRY L. KAMPHOFNER, *Dean*

The School of Design, as a statewide and regional design center, is devoted and dedicated to the development of an indigenous design and its accompanying art forms for the southern region. Although its first aim is to serve North Carolina and the South, the school also prepares its students to work in any region. The goal of the design student is to master professional techniques and to meet the challenge of any environment.

The School of Design has become an international educational center, serving to unify fundamental knowledge and methods shared by the several design professions. The school includes the Departments of Architecture, Landscape Architecture and Product Design. Following selection of specialization at the end of the second year, the students still have an opportunity to work with students and faculty in the other two departments.

The school has recently established new six-year programs in architecture and landscape architecture which will lead to the Bachelor of Environmental Design after four years and the Master of Architecture and the Master of Landscape Architecture after two additional years. The present five-year program in product design has been revised but will continue as a five-year program leading to the Bachelor of Product Design. The five-year program in product design will require 153 hours. The six-year program in architecture will require 177 hours, and the six-year program in landscape architecture will also require 177 hours. There is also a two-year graduate program in urban design with a normal requirement of 48 hours. Graduate studies in product design will lead to the Master of Product Design. Those students with a four-year undergraduate degree will be required to complete a minimum of 48 hours of course work, and those with a five-year undergraduate degree will be required to complete a minimum of 30 hours of course work.

Design students receive training in perception and communication and advanced studies in visual communication as well as instruction in other courses offered in the School of Design and instruction in other schools at North Carolina State University.

The design faculty seeks to develop the student's personality and character as a whole. Individual creative expression is emphasized, but teamwork is also encouraged. In its teaching the faculty gives attention to the art of humanizing the environment.

The school educates men to be competent within the specific demands and limitations of a particular professional field, but the entire program is based on a belief in the basic flexibility of the design process. In the three professional fields methods and values common to all three are studied and are separated only in the study of their application to a single profession.

THE COMMON FIRST TWO YEARS

The common first two years or the basic design program, encompassing the first two years of the student's design education, has its foundation in the student's utilization of his previous development as he initiates his design education. When he is able to clearly define and express his interests, the course structure can be molded to accommodate him. As students begin the selection of their professional education, there is considerable variation in their directions. In order for the student of design to make a choice that would be in his best

interest, he will first need exposure to situations in which he can learn to explicitly define the alternatives. Therefore, the basic design program offers the learner a range of diverse experiences. These experiences are gained through active participation in the academic community as a whole, as well as those courses offered within the School of Design. A program that encourages students to discover various interfaces that occur between the actions of the participant and the environment for design is properly an interdisciplinary activity which utilizes the knowledge from a variety of related disciplines. He achieves, through physical form, an expression of the complex values and meanings of our society.

CURRICULA AND DEGREES

The School of Design offers undergraduate instruction in architecture, landscape architecture and product design. The school also offers graduate studies in four distinct fields—architecture, urban design, landscape architecture and product design. The four-year undergraduate programs in architecture and landscape architecture lead to the Bachelor of Environmental Design degree. Graduate programs leading to the Master of Architecture degree and Master of Landscape Architecture degree normally require two years of residence although they may be extended for students who enter the fields from non-design backgrounds. The Master of Urban Design program also requires two or more years and is open to students from non-design as well as design backgrounds. The undergraduate program in product design which offers an option in visual design requires five years for the Bachelor of Product Design degree. The Master of Product Design degree requires a year or more of graduate studies, depending on the preparation of the student applicant.

FACILITIES

The School of Design is located in Brooks Hall, the former college library. The main building and a large additional space in nearby Leazar Hall provide 73,000 square feet of space for offices, classrooms, drafting rooms and studios as well as laboratories for design research. The school has well-equipped and supervised shop facilities. The design library contains more than 12,223 volumes, 21,006 slides and subscriptions to 189 design periodicals. The drafting rooms and studios have been designed to accommodate small classes, thereby assuring a personal relationship between teacher and student in the development of the student's creative abilities. All facilities in the school have been planned to provide a scholarly environment for effective teaching and laboratory instruction.

OPPORTUNITIES

State law now requires the graduate architect to work not less than three years in the offices of registered architects and then to pass the four-day written examination given by the North Carolina Board of Architecture before he is ready to begin his own practice. Accelerating activity in building construction and urban redevelopment has brought about a significant increase in work in architectural offices in the South, offering many attractive positions for the architecture graduate. The architecture graduate is also qualified for positions in certain branches of engineering, building research and teaching.

The accelerated urban growth of the 20th century has created an unprecedented demand for landscape architects that far exceeds the production of the schools. Positions exist in both public and private organizations, encompassing a range of interests from city and regional planning to residential developments. For the competent graduate, advancement is rapid and remuneration above average.

The Department of Product Design, which was established in September

1958 as the third department of the school, prepares its graduates to work as resident designers with such industries as furniture manufacturing and other essential and important industries of North Carolina and the region. Graduates of the department are also qualified to establish offices as professional industrial designers.

Evidence of the soundness of the course of study and the programs in design at North Carolina State University is reflected by three of the school's graduates who have been awarded fellowships to the American Academy in Rome—a prize awarded annually to design graduates in the United States and affording two years of advanced study in Europe, providing all expenses and residence at the American Academy in Rome. Five graduates of the school have won the top academic award in architecture, the Paris Prize, which is a scholarship worth \$5,000 for a year's study in Europe. Seventeen graduates of the school have won the coveted Fulbright Scholarship for foreign travel and study. The faculty, graduates and students of the school have won more than \$350,000 in prizes and scholarships since the establishment of the school in 1948.

ARCHITECTURE

Brooks Hall

Professor ROBERT P. BURNS, JR., *Head of the Department*

Professors: J. H. COX, H. H. HARRIS, H. L. KAMPHOEFFNER, D. R. STUART;
Associate Professors: P. BATCHELOR, G. L. BIRELINE, JR., H. SANOFF, V. SHOGREN; *Visiting Associate Professor:* I. M. ZUBIZARRETA; *Assistant Professors:* D. W. BARNES, JR., E. P. BRANTLY, R. H. CLARK, LYNNE M. GAY, M. G. HANCOCK, E. KAYARI, G. J. P. REUER, S. W. ROSE, E. W. TAYLOR;
Librarian: HELEN K. ZSCHAU

Architecture finds itself, upon entering the final three decades of the 20th century, at a critical stage in its historical development. The architect's traditional problem of giving meaningful form to man's physical environment remains his chief concern, but this task has been vastly complicated by the forces of accelerating world urbanization and the technological revolution which is rapidly altering every facet of contemporary life. Social upheaval in the cities, ruthless violation of our landscape and natural resources, congestion and decay of our urban centers, obsolescence and inefficiency at every level of our transportation systems, the tendency toward giantism and anonymity in all of man's institutions—these are but a few elements in the complex condition of modern society with which the architect is confronted. The pastoral, the picturesque, the arrogantly lavish and the purely aesthetic have little relevance for a society whose design needs are so demanding that only the most broadly educated, intelligent and creative professionals can hope to cope with them. It is this type of professional that the Department of Architecture attempts to prepare—individuals with a profound understanding of man and his cultural context, with a deep commitment to the ordering of the physical environment, and with the necessary tools for accomplishing these objectives.

Inherent in the architectural program is recognition of the evolving role of the architect. While individual creativity and decision-making abilities are no less important, it is clear that the architect increasingly functions as member and frequently as coordinator of a team of professionals—engineers, planners, political and behavioral scientists, economists and others—who together are able to formulate the comprehensive programs adequate to meet today's most urgent environmental problems.

It becomes obvious that no monolithic academic program can serve the requirements of architecture students with highly divergent interests and capabilities, nor indeed the varied needs of the present-day architecture profession. The curriculum in architecture, while providing a broad basic structure common to all students, encourages individual diversity through a major elective program of in-depth study in one of several design-related fields leading to expanded backgrounds in social and cultural factors, programming and analytic methods, technological issues, urban affairs, visual studies, management and operations, economics or natural systems. Through interdisciplinary studies in the school and University and through the use of outside consultants, the interdependence of the architect with related professionals is strongly emphasized. The design studio is transformed into a working laboratory in which analysis and synthesis become real and meaningful activities to the students.

Considering the changing requirements in the field of architecture, and the increasing complexity of tasks facing today's architect, a six-year, two-degree curriculum has been inaugurated, replacing the previous five-year Bachelor of Architecture program. The major characteristic of the new curriculum is the formal organization of studies into logical two-year cycles.

The freshman and sophomore years combining general studies and introductory design exercises constitute the "Basic Design Program" common to all architecture, landscape architecture and product design students in the School of Design.

The junior and senior years mark the formal introduction to architectural studies and form the "Preprofessional Program." This first four-year program requires 129 semester hours and leads to the nonprofessional degree of Bachelor of Environmental Design. The third cycle is designated as the "Professional Program" in which the student undertakes two years of graduate study leading to the professional degree of Master of Architecture.

For students not advancing to the final cycle of graduate studies, the four-year undergraduate curriculum is designed as a terminal program qualifying graduates to enter architecture on a subprofessional level or related fields outside of architecture.

In terms of its larger responsibilities in the total preparation of the architect, the Department of Architecture acknowledges a divided but overlapping obligation with the profession. While office experience should extend the young architect's knowledge of technical aspects as well as judgmental maturity during the period of apprenticeship, it is the particular task of the department and the University to develop fundamental abilities in conceptual and developmental design and to provide a philosophical and theoretical basis for creative life as an architect and as an individual.

ARCHITECTURE CURRICULUM

FIRST YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
DN 101 Environmental Design I	4	DN 102 Environmental Design II	4
DN 111 Perception and Communication I	2	DN 112 Perception and Communication II	2
DN 121 History of Design	3	DN 122 History of Design II	3
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
Math*	3 or 4	Math*	3 or 4
Physical Education	1	Physical Education	1
<hr/>		<hr/>	
16 or 17		16 or 17	

SECOND YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
DN 201 Environmental Design III	4	DN 202 Environmental Design IV	4
DN 211 Visual Communication I	2	DN 212 Visual Communication II	2
Required Science Elective**	4	Required Science Elective**	4
Electives*****	6	Electives*****	6
Physical Education	1	Physical Education	1
<hr/>		<hr/>	
17		17	

THIRD AND FOURTH YEARS

ARC 400 Intermediate Architectural Design (Series)***	16
Structures	12
Professional Options****	10
Electives*****	24
	<hr/> 62

Total Hours for the Bachelor of Environmental Design in Architecture—129

* Excluding credit for Math 111, must include one calculus course.

** Selected from natural, physical or biological sciences, but not to include math or computer science.

*** Four semesters at 4 credit hours per semester required in Intermediate Architectural Design or equivalent.

**** To be selected from professional options offered in the School of Design or other equivalent courses offered in the University. Must include ARC 331 and ARC 332.

***** Thirty-six credit hours of electives which will be divided into three equal groups of 12 hours each.

a. Social science-humanities group.

b. Advised group—selected by student with adviser's approval to develop an area of concentration outside his major.

c. Unrestricted group.

LANDSCAPE ARCHITECTURE

Brooks Hall

Associate Professor R. R. WILKINSON, Head of the Department

Professors: J. H. COX, D. R. STUART, E. G. THURLOW; Associate Professors: G. L. BIRELINE, JR., R. MUSSELWHITE; Assistant Professors: D. H. ENSIGN, R. T. HESTER, JR., W. MAYNARD, J. A. PORTER

Landscape architecture is the design profession charged with the stewardship of the landscape. A prime responsibility within that charge is the development and application of the skill to arrange man-made features on the landscape for their use by society. Environmental quality is the standard of achievement in the profession. There are approximately 7500 professional landscape architects practicing in the United States. Their activities range from site planning for urban complexes, community design, park and open space design, campus planning to the development of regional networks of transportation, recreation and cities. The federal government is the largest employer of landscape architects. Many are owners and associates in private consulting firms designing facilities for the entire range of community and institutional building programs.

The Department of Landscape Architecture at North Carolina State University is committed to preparing students for careers in environmental and landscape design. The design disciplines, however, are not producers of the knowledge necessary to support their activities; they are consumers. The educational function of design schools is to develop in young people the basic understanding of the natural and social world. Formal insights gained from the sciences and arts are applied to a wide range of environmental problems through the professional courses.

The emphasis in the professional course work is basic problem-solving, technical competence and innovation. The latter is an extension of the aesthetic appreciation that has been the traditional role of design. The faculty is very much aware of the state of decay, misuse and poor judgment that has become our environmental legacy. It is a matter of urgency that young people be capable of understanding the process of physical development and be committed to its application for the benefit of future as well as present users.

The challenge facing young designers is enormous and the reward can be a personally satisfying, creative and essential career.

LANDSCAPE ARCHITECTURE CURRICULUM

FIRST YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
DN 101 Environmental Design I	4	DN 102 Environmental Design II	4
DN 111 Perception and Communication I ..	2	DN 112 Perception and Communication II ..	2
DN 121 History of Design I	3	DN 122 History of Design II	3
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
Math*	3 or 4	Math*	3 or 4
Physical Education	1	Physical Education	1
	<hr/> 16 or 17		<hr/> 16 or 17

SECOND YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
DN 201 Environmental Design III	4	DN 202 Environmental Design IV	4
DN 211 Visual Communication I	2	DN 212 Visual Communication II	2
Required Science Elective**	4	Required Science Elective**	4
Electives***	6	Electives***	6
Physical Education	1	Physical Education	1
	<hr/> 17		<hr/> 17

THIRD AND FOURTH YEARS

LAR 400 Intermediate Landscape Architecture Design (Series)****	16
DN 422 History of Design IV	3
Landscape Technology*****	9
Professional Options*****	10
Electives***	24
	<hr/> 62

Total Hours for the Bachelor of Environmental
Design in Landscape Architecture—129

* Excluding credit for Math 111, must include one calculus course.

** Selected from natural, physical or biological sciences, but not to include math or computer science.

*** Thirty-six credit hours of electives which will be divided into three groups, 12 hours each.

a. Social science and humanities group.

b. Advised group of electives selected by student with adviser's approval to develop an area of concentration outside his major.

c. Unrestricted group.

**** LAR 400 Series: 4 semesters at 4 credit hours each. Required in landscape architectural design or equivalent.

***** Landscape Technology Series to be elected from departmental offerings or equivalent courses within the University.

***** Professional options to be selected from professional options in the School of Design or other equivalent courses within the University and to include ARC 441 Design Methods.

PRODUCT DESIGN

Brooks Hall

Assistant Professor V. M. FOOTE, Acting Head of the Department

Professors: W. P. BAERMANN, J. H. COX, D. R. STUART; Associate Professors:

G. L. BIRELINE, JR., F. EICHENBERGER, H. A. MACKIE, D. A. MASTERTON,

R. W. MUSSELWHITE; Assistant Professors: R. R. DRAKE, G. HEDGE

Product design, or industrial design, has in the last 35 years grown into a profession of eminent significance in the cultural and economic life of this country. While originally concerned solely with helping industry create mass-produced consumer products of good appearance, the profession has during the last two decades begun to play an increasingly important role as a synthesizing force in product planning, product research and total product development.

This means that the education of the product designer has shifted from the education of a stylist, concerned only with product appearance to the education of a designer concerned with such varying disciplines as psychology, engineering, manufacturing and marketing.

Since the department was founded nearly a decade ago, we have been engaged in training competent product designers able to operate effectively in any field of industry where innovation in problem solving is required. During the undergraduate program the Department of Product Design attempts to inculcate in the student a generalized rather than a specialized approach to the solution of design problems. The student is taught to treat man and his environment in terms of whole systems rather than isolated or component parts. Emphasis is placed on general overall solutions to human problems from which specific objects are extrapolated.

The growing affluence of our society has created an expanding need for new products. This coupled with an ever increasing middle class and shorter working hours has substantially broadened the industrial requirements for competent designers; designers who are able to handle the increasing complexities of materials and manufacturing developments, as well as satisfying the physical and psychological needs of the consumer.

In order to achieve these ends, it has become necessary for the designer to involve himself in three major design and research activities:

- a. Man's Behavior
- b. The Man-Machine Relationship
- c. The Machine Itself

Only the most broadly educated and talented designers are able to fulfill the needs of this new industrialized society, graduates who will aid in the solution of the numerous human problems that surround us on a regional, national and international scale.

VISUAL DESIGN OPTION

The modern world has come to the realization that science—until recently—has not felt it necessary for man to play a central role in the history of natural events. In the 20th century we have found that the new science of communication returns man to his world through the study of his interaction with external events. The raw materials for such interactions reach man through his perceptions, and the preponderant mass of such perceptions are visual. Within recent history an almost incredible expansion of communications media have created a demand for people with operational knowledge of the various forms of visual communication. One set of these demands has to do with people able to carry out activities which have come to be known as visual design.

The history of visual design is one of separate skills and crafts which have now merged into a cohesive field of study. Such activities are:

- a. Book, pamphlet and brochure design (publishing, typography, printing, etc.).
- b. Package design.
- c. Signing and symbol creation (indesimal and iconic indications).
- d. Advertising design (newspapers, magazines, cinema, TV).
- e. Educational and commercial exhibition and display design.
- f. Human factors information display design.
- g. Development of techniques for analyzing visual character and its relation to social and behavioral functions in the urban environment.
- h. Problem-solving approaches; exploration of visual means for solving socially defined problems.

Working through a broad range of visually creative experience, the student

will develop an understanding of elements and principles of visual organization common to all visual communication. Upon receiving his undergraduate degree the student would be prepared to enter the professional field or be in a position to enter graduate schools for continued study in specific areas.

The undergraduate curriculum in product design is a five-year program of study leading to the professional degree, Bachelor of Product Design. One hundred fifty-three hours are required for graduation.

PRODUCT DESIGN

FIRST YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
DN 101 Environmental Design I	4	DN 102 Environmental Design II	4
DN 111 Perception and Communication I ..	2	DN 112 Perception and Communication II ..	2
DN 121 History of Design I	3	DN 122 History of Design II	3
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
Math*	3 or 4	Math*	3 or 4
Physical Education	1	Physical Education	1
	<u>16 or 17</u>		<u>16 or 17</u>

SECOND YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
DN 201 Environmental Design III	4	DN 202 Environmental Design IV	4
DN 211 Visual Communication I	2	DN 212 Visual Communication II	2
Electives***	6	Electives***	6
Required Science Elective**	4	Required Science Elective**	4
Physical Education	1	Physical Education	1
	<u>17</u>		<u>17</u>

THIRD AND FOURTH YEARS

<i>Spring Semester</i>	<i>Credits</i>
PD 400 Intermediate Product Design (Series)****	16
PD 411, 412 Applied Physical Principles	6
Professional Options*****	16
Electives***	24
	<u>62</u>

FIFTH YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
PD 501 Advanced Product Design V	7	PD 502 Advanced Product Design VI	7
PD 590 Special Projects	3	PD 591 Special Projects	3
Electives*****	3	Electives*****	3
	<u>13</u>		<u>13</u>

Total Hours for the Bachelor of Product Design—153

* Excluding credit for MA 111, must include one calculus course.

** Selected from natural, physical or biological sciences, but not to include math or computer science.

*** Thirty-six credit hours of electives which will be divided into three groups, 12 hours each.

a. Social science and humanities group.

b. Advised group of electives selected by student with adviser's approval to develop an area of concentration outside his major.

c. Unrestricted group.

**** Four semesters at 4 credit hours per semester required in intermediate product design.

***** To be selected from professional option in the School of Design or other appropriate courses at the University, and must include four semesters of special projects 490 series; PD 321, 322; PD 421, 422; and PD 431, 432.

***** Selected, with adviser, to reinforce the student's professional goals.

PRODUCT DESIGN

VISUAL DESIGN OPTION

FIRST YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
DN 101 Environmental Design I	4	DN 102 Environmental Design II	4
DN 111 Perception and Communication I ..	2	DN 112 Perception and Communication II ..	2
DN 121 History of Design I	3	DN 122 History of Design II	3
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
Math*	3 or 4	Math*	3 or 4
Physical Education	1	Physical Education	1
	16 or 17		16 or 17

SECOND YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
DN 201 Environmental Design III	4	DN 202 Environmental Design IV	4
DN 211 Visual Communication I	2	DN 212 Visual Communication II	2
Required Science Elective**	4	Required Science Elective**	4
Electives***	6	Electives***	6
Physical Education	1	Physical Education	1
	17		17

THIRD AND FOURTH YEARS

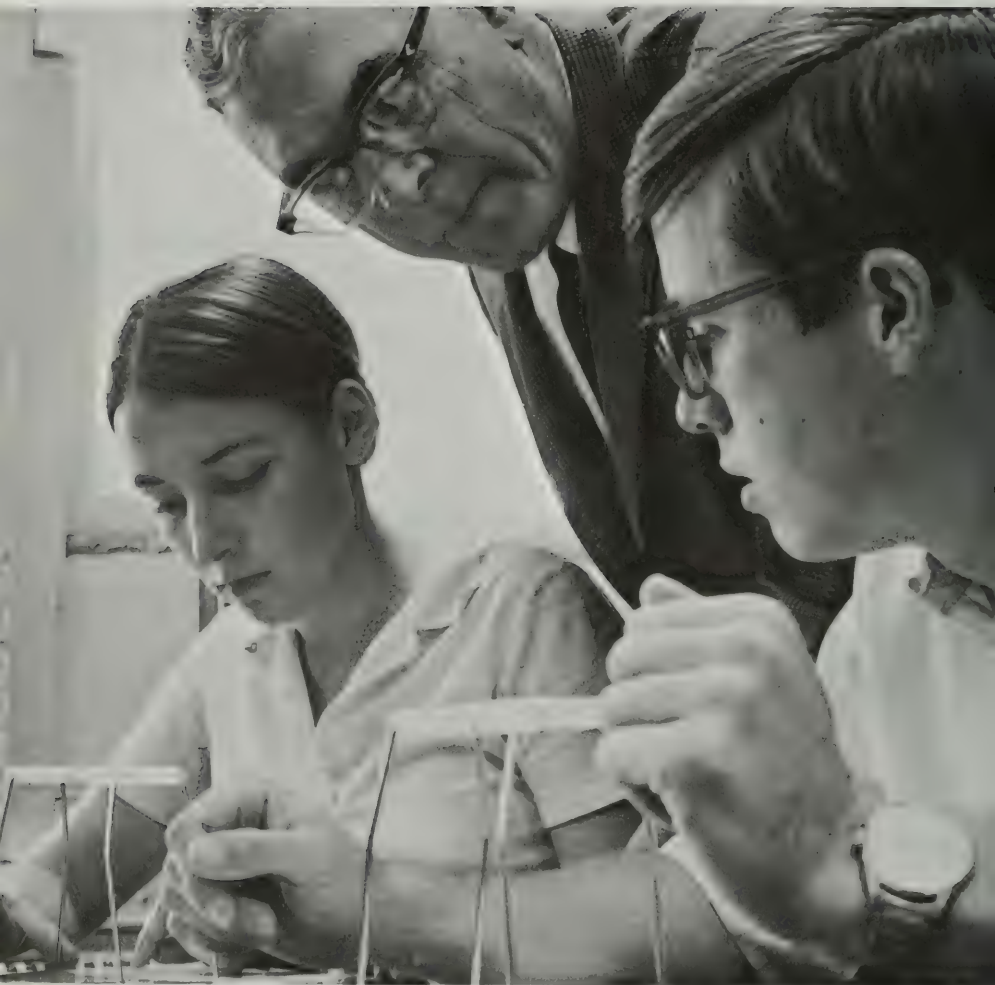
PD 440 Intermediate Visual Design (Series)****	16
PD 411, 412 Applied Physical Principles ..	6
Professional Options*****	16
Electives***	24
	62

FIFTH YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
PD 541 Advanced Visual Design I	6	PD 542 Advanced Visual Design II	6
PD 590 Special Projects	3	PD 591 Special Projects	3
Electives*****	3	Electives*****	3
	12		12

Total hours for the Bachelor of Product Design—Visual Design Option—153

* Excluding credit for MA 111, must include one calculus course.
 ** Selected from natural, physical or biological sciences, but not to include Math or computer science.
 *** Thirty-six credit hours of electives which will be divided into three groups, 12 hours each.
 a. Social science and humanities group.
 b. Advised group of electives selected by student with adviser's approval to develop an area of concentration outside his major.
 c. Unrestricted group.
 **** Four semesters at 4 credit hours per semester required in intermediate visual design.
 ***** To be selected from professional option in the School of Design or other appropriate courses at the University, and must include four semesters of special projects 490 series; PD 321, 322; PD 421, 422; and PD 431, 432.
 ***** Selected, with adviser, to reinforce the student's professional goals.



More and more science teachers are needed each year because of rapid increases in enrollments of our public schools.

EDUCATION

Poe Hall

CARL J. DOLCE, *Dean*

J. BRYANT KIRKLAND, *Dean Emeritus*

The School of Education is concerned with the problems of human development both in the setting of schools and in less traditional types of educational activities. With an emphasis upon the preparation of teachers, the school seeks students who are dedicated to the improvement of mankind through education and who are sensitive to the feelings, desires and aspirations of others.

The school is composed of the Departments of Adult Education, Agricultural Education, Industrial and Technical Education, Mathematics and Science Education, Guidance and Personnel Services, and Psychology.

Undergraduate degree programs are offered in agricultural education, industrial arts education, vocational industrial education, technical education, mathematics education, science education and psychology.

Graduate degree programs are offered in adult education, agricultural education, industrial arts education, vocational industrial education, technical education, mathematics education, science education, guidance and personnel services, psychology, and occupational education.

Graduates of the undergraduate programs in education receive a Bachelor of Science degree in education and qualify for a Grade "A" Certificate to teach in their chosen fields. Graduates of the undergraduate program in psychology receive a Bachelor of Arts in psychology degree. Graduate programs confer the Master of Science or Master of Education degrees.

Professional education courses are provided for those students enrolled in the School of Liberal Arts who wish to become teachers of English, social studies, modern foreign languages and speech.

A modern, well-equipped School of Education building has been completed recently. The new building includes a curriculum materials center, industrial arts laboratories, science laboratories, as well as the latest developments in teaching technology, child play and guidance observation rooms.

ADULT AND COMMUNITY COLLEGE EDUCATION

(Also see agriculture and life sciences.)

Ricks Hall

Professor E. J. BOONE, *Head of the Department*

TEACHING, RESEARCH AND EXTENSION

Professors: R. J. DOLAN, J. D. GEORGE, EMILY H. QUINN; *Visiting Extension Professor:* MARY L. COLLINGS; *Associate Professors:* D. A. ADAMS, W. L. CARPENTER; *Adjunct Associate Professor:* J. E. ROUECHE; *Associate Professor:* W. L. FLOWERS; *Assistant Professors:* D. B. LUMSDEN, G. E. PARSONS, G. D. RUSSELL, R. W. SHEARON; *Adjunct Assistant Professors:* B. R. HERRSCHER, C. J. LAW; *Visiting Extension Assistant Professor:* J. F. SCHULZE; *Extension Instructor:* J. D. DODSON

The adult and community college education faculty offers instruction at advanced undergraduate and graduate levels. The advanced undergraduate courses are designed to support the other departments of the institution, giving students

a background in adult and community college education. The graduate program is designed to increase the professional competence of adult and community college educators in developing and administering adult and community college education programs and in conducting scholarly research in the field.

UNDERGRADUATE PROGRAM

The department does not have a program leading to a Bachelor of Science degree.

GRADUATE STUDY

The department offers the Master of Science, Master of Education or Doctor of Education degrees with a major in adult and community college education. Prospective applicants should consult the Graduate School Catalog.

AGRICULTURAL EDUCATION

Poe Hall

Professor C. C. SCARBOROUGH, Head of the Department

Professor: J. K. COSTER; Professor Emeritus: J. B. KIRKLAND; Associate Professors: H. G. BEARD, T. R. MILLER; Research Associate Professor: C. H. ROGERS; Assistant Professor: C. D. BRYANT; Adjunct Assistant Professor: W. J. BROWN, Jr.; Visiting Assistant Professor: R. J. MERCER

Agricultural education in its broadest sense, should encompass areas of study which will enable one to participate effectively in planning, promoting and initiating programs in occupational education in agriculture. Therefore, the description of a graduate in agricultural education would be more nearly an "educational leader" than an "agricultural specialist."

UNDERGRADUATE PROGRAM

The program in agricultural education includes education for personal development, community living, citizenship, home living and educational leadership. These areas in the program are divided into three groups: (1) general education; (2) technical or special education, and (3) professional education.

General education includes the education which everyone should have, namely, preparation for living effectively (1) with one's self, (2) with one's family, (3) in a community, (4) as a local, state, national and world citizen, and (5) bringing to bear the knowledge of man in solving problems.

Special, or technical education, consists of securing an understanding and ability to solve agricultural problems, with emphasis upon managerial aspects. There is now a choice of specialty areas in agriculture, as well as qualifying as a "double major."

Professional education includes an understanding of human behavior and development. Particular attention is given to an understanding of the learning process—as it occurs and how it can be accelerated. Consideration is also given to understanding how people work together in groups, particularly in rural communities. Ability to do research in the community is essential.

The highlight of the curriculum for most students is the student teaching semester which provides full-time teaching and related experiences in occupational education programs.

FACILITIES AND RESOURCES

In addition to the University facilities and resources, the administrative personnel of most of the agricultural and educational agencies and programs have offices in Raleigh. These people often serve as valuable resource people to students in agricultural education.

AGRICULTURAL EDUCATION CURRICULUM

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ALS 103	1	ENG 112 Comp. & Reading	3
BS 100 Gen. Biology	4	Math Elective	3-4
ED 102 Obj. in Ag. Ed.	1	Animal Sc. Elec.	4
ENG 111 Comp. & Rhet.	3	Plant Sc. Elec.	3
History Elective	3	Physical Education	1
MA 111 Alg. & Trig.	4		
Physical Education	1		
	<hr/> 17		<hr/> 14-15

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EC 205 Economic Activity	3	EC 212 Econ. of Agriculture	3
CH 111 Foundations of Chemistry	5	PY 221 College Physics	5
BAE 211 Farm Machinery	4	SSC 200 Soils	4
Agricultural Elective	3	PSY 200 Intro. to Psy.	3
Physical Education	1	Physical Education	1
	<hr/> 16		<hr/> 16

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 344 Secondary Education	3	ED 313 Contemporary Vo Ag	3
SOC 202 Principles of Sociology	3	PSY 304 Educational Psychology	3
Agri. Specialty	3	PS 201 American Gov. Systems	3
Fine Arts Elective	3	SP 230 Fundamentals of Speech	3
Elective	3	Agri. Specialty	3
	<hr/> 15	Elective	3
			<hr/> 18

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 411 Student Teaching in Agri.*	6	Agri. Specialty	3
ED 412 Teaching Adults*	2	Literature Elective	3
ED 413 Plan. Ed. Programs*	2	Phil. or Religion Elec.	3
ED 420 Prin. of Guidance*	2	Elective	6
PSY 476 Psy. of Adolescence*	2		
SOC 416 Research Methods*	3		
	<hr/> 17		<hr/> 15
		Total Hours—128	

* These courses are taken as a block in the professional semester.

GUIDANCE AND PERSONNEL SERVICES

Poe Hall

Professor W. E. HOPKE, Head of the Department

Professors: R. N. ANDERSON, C. G. MOREHEAD; Associate Professor: B. C. TALLEY; Assistant Professor: BARBARA M. PARRAMORE

The department offers work leading to the Master of Science, Master of Education, sixth year and Doctor of Education degrees with a major in the field of guidance and personnel services (or counselor education). Each of these degrees is designed to prepare individuals for guidance and personnel positions at

various levels in elementary and secondary schools, junior and community colleges, trade and technical schools and institutes, institutions of higher education, agencies (such as employment and rehabilitation offices), as well as guidance and personnel work in business, industry and government. Prospective applicants should consult the Graduate School Catalog.

INDUSTRIAL AND TECHNICAL EDUCATION

Poe Hall

Professor D. M. HANSON, Head of the Department

Professors: J. T. NERDEN, D. W. OLSON; Professor Emeritus: I. HOSTETLER; Associate Professors: C. A. MOELLER, T. B. YOUNG; Assistant Professors: T. C. SHORE, JR., F. S. SMITH, R. T. TROXLER; Adjunct Assistant Professor: W. A. MCINTOSH; Visiting Assistant Professor: C. F. WARD; Instructor: R. L. MILLER

The Department of Industrial and Technical Education offers curricula to prepare teachers, supervisors and administrators for the public schools, area vocational schools, community colleges and technical institutes. Complete four-year curricula in industrial arts education, vocational industrial education and technical education leading to the Bachelor of Science in education degree are available in the department. The curricula are planned to provide students with broad cultural and professional backgrounds to parallel occupational experience.

OPPORTUNITIES

Students completing the requirements of the industrial and technical education curricula will be prepared to teach industrial arts or trade and/or technical subjects. Students may also prepare for positions as industrial cooperative training coordinators in secondary schools.

GRADUATE STUDY

The department offers the Master of Science, Master of Education or Doctor of Education degrees. Prospective applicants should consult the Graduate School Catalog.

VOCATIONAL INDUSTRIAL EDUCATION

Poe Hall

The curriculum in vocational industrial education is designed to prepare vocational teachers for the secondary schools, area vocational schools and post-secondary school vocational programs. Upon satisfactory completion of the curriculum the graduate is qualified to teach in any of the aforementioned vocational areas.

OPPORTUNITIES

Graduates of the vocational industrial education curriculum have a wide selection of employment opportunities. The rapid growth of the vocational programs in the secondary schools in all fields has created an urgent demand for vocational teachers, and the selection is very attractive. A student may qualify for teaching positions in introduction to industrial education, trade preparatory

training and industrial cooperative training in these fast-growing programs in the secondary schools.

Other opportunities include teaching in the area vocational schools, in industry and in the post-secondary schools.

VOCATIONAL INDUSTRIAL EDUCATION CURRICULUM

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chem. I	4	ENG 112 Comp. and Reading	3
ED 100 Intro. Ind. Educ.	2	History Elective	3
ENG 111 Comp. & Rhetoric	3	IA 105 Drafting	4
MA 111 Algebra & Trig.	4	MA 112 Analytic Geo. & Calc. A	
Physical Education	1	or	
	14	MA 122 Math of Fin. & Elem. Stat.	4
		Physical Education	1
			15

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
PS 201 The Amer. Gov. System	3	EC 205 Economic Activity	3
PSY 200 Intro. to Psychology	3	PY 212 General Physics	4
PY 211 General Physics	4	SOC 202 Principles of Sociology	3
SP 230 Fundamentals of Speech	3	Electives*	6
Electives*	3	Physical Education	1
Physical Education	1		17
	17		

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 327 Hist. & Phil. of Ind. Tech. Educ.	3	ED 305 Anal. of Tech. Ed. Progs. & Course Construction	3
PSY 304 Educational Psychology	3	ED 344 Secondary Education	3
RRA 333 Safety Prac. in Rec.	2	Literature Elective	3
SOC 401 Human Relations in Industrial Society	3	Electives*	8
Electives*	6		17
	17		

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 420 Principles of Guidance	2	EC 425 Industrial Management	3
ED 422 Methods of Teaching Industrial Subjects	3	ED 405 Ind. & Tech. Ed. Shop and Lab Planning	3
ED 444 Student Teaching in Industrial Subjects	6	ED 440 Vocational Education	2
ED 483 Instructional Aids & Devices	2	Electives*	8
PSY 476 Psy. of Adolescence	2		16
	15		

Total Hours—128

* Eighteen hours of electives must be selected in accordance with the student's area of specialization and with approval of the adviser. Remaining hours may be taken from free electives.

TECHNICAL EDUCATION

Poe Hall

The curriculum in technical education is oriented toward achieving the objective of preparing instructors within a wide range of teaching technologies and is closely coordinated with existing engineering curricula. A student enrolling in the technical education curriculum may specialize to some extent in areas related to interest and/or previous work experience. Admission to the technical education

curriculum is limited to students capable of demonstrating proficiency in a given applied technology, i.e., electrical, electronics, mechanical, etc.

OPPORTUNITIES

Many employment opportunities exist for graduates of the technical education curriculum. These include teaching in the expanding community college complex, technical institutes, area vocational schools and within industry as instructors and coordinators of training programs. The growth of technical education in the nation, and the large number of new technical education facilities being constructed will require an increasing number of instructors to staff teaching positions.

TECHNICAL EDUCATION CURRICULUM*

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I	4	EC 205 Economic Activity	3
ED 100 Intro. to Ind. Ed.	2	ENG 112 Comp. and Reading	3
ENG 111 Comp. and Rhetoric	3	MA 102 Anal. Geo. and Calc. I	4
MA 111 Algebra and Trig.	4	PS 201 The Amer. Gov. System	3
Physical Education	1	Physical Education	1
	<u>14</u>		<u>14</u>

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
E 101 Engineering Graphics I	2	E 102 Engineering Graphics II	1
English Elective	3	PSY 200 Intro. to Psychology	3
MA 201 Anal. Geo. and Calc. II	4	PY 208 General Physics	
PY 205 General Physics		or	
or		PY 212 General Physics	5 or 4
PY 211 General Physics	4	Electives**	5 or 4
Physical Education	1	Physical Education	1
	<u>14</u>		<u>14</u>

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 327 Hist. & Phil. of Ind. Tech Ed.	3	ED 305 Anal. of Tech. Ed. Progs.	3
PSY 304 Educational Psychology	3	and Course Construction	3
SOC 202 Prin. of Sociology	3	SOC 401 Human Rel. in Ind. Society	3
Electives**	6	Electives**	9
	<u>15</u>		<u>15</u>

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 405 Ind. & Tech. Ed. Shop		ED 444 Student Teaching in Ind.	
and Lab. Planning	3	Subjects	6
ED 422 Meth. of Teach. Ind. Subjects	3	Electives**	9
Electives**	9		<u>15</u>
	<u>15</u>	Total Hours—116	

* Student will be expected to demonstrate proficiency in the applied technology of his choice—may be fulfilled by technical institute training or selected courses in addition to those required for the degree.

** Minimum of 27 hours of elective courses must be selected from engineering, engineering sciences, physical sciences, etc. in accordance with the student's area of specialization and with approval of the adviser. Remaining hours may be taken from free electives.

INDUSTRIAL ARTS EDUCATION

Poe Hall

Associate Professor T. B. YOUNG, Coordinator

Industrial arts comprises that area of education which concerns itself with materials, processes and products of industry. It is concerned with a study of changes made in materials to make them more useful and with problems related to these changes.

The industrial arts education curriculum at North Carolina State performs the function of preparing teachers and supervisors of industrial arts for secondary schools.

FACILITIES

The industrial arts facilities include a drafting room, and various laboratories which include test and machine tool equipment for student activities involving wood, metals, plastics, ceramics, electricity and electronics, and graphic arts. A separate experimental laboratory is provided for the purpose of encouraging experimentation and applied research in all of the industrial arts areas at the advanced undergraduate and graduate levels.

OPPORTUNITIES

The graduates of the industrial arts program find excellent opportunities for employment in the public schools, as well as in business and industry.

INDUSTRIAL ARTS EDUCATION CURRICULUM

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I	4	ENG 112 Comp. & Reading	3
ENG 111 Comp. & Rhetoric	3	IA 105 Drafting	4
IA 100 Intro. to Ind. Arts	1	MA 112 Anal. Geo. and Calc. A	4
IA 102 Fund. of Mat. & Processes	4	PS 201 The Amer. Gov. System	3
MA 111 Alg. & Trig.	4	Physical Education	1
Physical Education	1		—
	17		15

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
IA 209 Wood Processing	4	EC 205 Economic Activity	3
PSY 200 Intro. to Psy.	3	IA 210 Metal Technology	4
PY 211 General Physics	4	PY 212 General Physics	4
SOC 202 Prin. of Sociology	3	Speech Elective	3
Physical Education	1	Elective*	3
	15	Physical Education	1
			—
			18

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
IA 205 Ind. Arts Design	3	ED 344 Secondary Education	3
IA 312 Electricity-Electronics	4	ED 482 Curriculum Prob. in Ind. Arts	2
IA 484 School Shop Plan. and Equipment Selection	3	IA 304 General Shop Organization	2
PSY 304 Educ. Psychology	3	IA 306 Graphic Arts	4
Electives*	6	IA 315 General Ceramics	3
	19	Literature Elective	3
			—
			17

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 420 Prin. of Guidance	2	History Elective	3
ED 422 Meth. of Teach. Ind. Subjects	3	IA 465 Indep. Study in Ind. Arts	3
ED 444 Stud. Teach. in Ind. Subjects	6	IA 480 Modern Industries	3
ED 483 Instru. Aids & Devices	2	Electives*	9
PSY 476 Psy. of Adolescence	2		18
	15	Total Hours—134	

* To provide depth of experience in one or two areas of industrial arts, nine additional hours are required in one area or six additional hours in one and three in another.

MATHEMATICS AND SCIENCE EDUCATION

Poe Hall

Professor H. E. SPEECE, Head of the Department

Associate Professors: N. D. ANDERSON, J. R. KOLB, H. A. SHANNON; Assistant Professor: L. W. WATSON; Adjunct Assistant Professors: E. G. BLAKEWAY, J. M. GOODE, ANNIE J. WILLIAMS; Instructor: W. M. WATERS, JR.

The Department of Mathematics and Science Education offers a program for preparing undergraduate students as teachers of mathematics and science. The program is designed to provide a broad background in the natural sciences, social sciences and humanities; depth of specialization in mathematics or an area of science; and the development of professional competencies needed by a teacher. There is sufficient flexibility in the program to allow students to meet certification requirements in more than one teaching field. The depth of preparation in the area of specialization will enable students to pursue a program of graduate studies.

OPPORTUNITIES

The demand for well-qualified mathematics and science teachers in our schools and colleges results in excellent opportunities for graduates of the Department of Mathematics and Science Education. The rapid scientific, technological and educational developments during the past few years have accentuated the importance of mathematics and science teaching. These recent developments have resulted in improved working conditions, salaries, and new opportunities for graduate study and professional advancement.

MATHEMATICS EDUCATION CURRICULUM

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I	4	BS 100 General Biology	4
ENG 111 Composition & Rhetoric	3	CH 103 General Chemistry II	4
History Elective	3	or	
MA 111 Algebra & Trigonometry	4	CH 107 Principles of Chemistry	4
Physical Education	1	ENG 112 Composition & Reading	3
	15	MA 102 Anal. Geom. & Calculus I	4
		Physical Education	1
			16

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 201 Anal. Geom. & Calculus II	4	EC 205 Economic Activity	3
PS 201 The American Gov. Systems	3	ED 203 Introduction to Teaching Math.	2
PSY 200 Introduction to Psychology	3	and Sci.	2
PY 211 General Physics*	4	MA 202 Anal. Geom. & Calculus III	4
Physical Education	1	PY 212 General Physics*	4
	15	ST 361 Intro. to Statistics for	1
		Engineers I	3
		Physical Education	1
			17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 344 Secondary Education	3	Literature Elective	3
MUS 200 Music in Contemp. Life	3	MA 404 Fund. Concepts of Geometry	3
or		PHI 201 Logic	3
ART 200 The Visual Arts in Cont. Life ..	3	PSY 304 Educational Psychology	3
MA 403 Intro. to Mod. Algebra	3	SOC 202 Principles of Sociology	3
Math Elective	3	Elective(s)	3
SP 230 Fundamentals of Speech	3		
Elective	3		
	<hr/> 18		<hr/> 18

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 420 Principles of Guidance**	2	MA 408 Advanced Geometry	3
ED 470 Methods of Teaching Math	3	MA 433 History of Mathematics	3
ED 471 Student Teaching in Math	6	PY 223 Astronomy & Astrophysics	3
ED 472 Dev. & Selecting Teaching		Electives	7
Materials in Math	2		
PSY 476 Psychology of Adolescence	2		
	<hr/> 15	Total Hours—130	<hr/> 16

* Students may schedule PY 205, 208, or PY 205, 206, 207 in place of the PY 211, 212 sequence.

** These courses are taken as a block in the professional semester.

SCIENCE EDUCATION CURRICULUM

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I	4	BS 100 General Biology	4
ENG 111 Composition & Rhetoric	3	CH 103 General Chemistry II	4
History Elective	3	or	
MA 111 Algebra & Trigonometry	4	CH 107 Principles of Chemistry*	4
Physical Education	1	ENG 112 Composition & Reading	3
	<hr/> 15	MA 102 Anal. Geom. & Calculus I	4
		or	
		MA 112 Anal. Geom. & Calculus A	4
		Physical Education	1
			<hr/> 16

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
GY 120 Physical Geology	3	ED 203 Introduction to Teaching	2
PSY 200 Introduction to Psychology	3	PS 201 The Amer. Gov'tal. Systems	3
PY 211 General Physics**	4	PY 212 General Physics**	4
SOC 202 Principles of Sociology	3	Required science or Electives***	6
Required science or Electives***	3	Physical Education	1
Physical Education	1		
	<hr/> 17		<hr/> 16

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EC 205 Economic Activity	3	Literature Elective	3
ED 344 Secondary Education	3	PSY 304 Educational Psychology	3
MUS 200 Music in Cont. Life	3	Req. Sci. or Elect.***	12
or			
ART 200 The Visual Arts in Cont. Life ..	3		
SP 230 Fundamentals of Speech	3		
Req. Sci. or Elect.***	6		
	<hr/> 18		<hr/> 18

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ED 420 Principles of Guidance****	2	PHI 405 Philosophy of Science	3
ED 475 Methods of Teach. Science	3	Req. Sci. or Elect.***	12
ED 476 Student Teaching in Science	6		15
ED 477 Dev. & Selecting Teaching			
Materials in Science	2		
PSY 476 Psychology of Adolescence	2		
	15	Total Hours—130	

* Required of those specializing in chemistry.

** Students may elect to schedule PY 205, 208 or PY 205, 206, 207 in place of the PY 211, 212 sequence.

*** In addition to required science, electives are to be selected for a minimum of 24 hours in the area of specialization.

**** These courses are taken as a block in the professional semester.

SCIENCE EDUCATION REQUIREMENTS IN AREAS OF SPECIALIZATION

Biology:

Plant Physiology (BO 421) or	
Vertebrate Physiology (ZO 421)	4
Genetics (GN 301 or GN 411-412)	3-4
Organic Chemistry (CH 220)	4
Plant Life (BO 200)	4
or	
Animal Life (ZO 201)	4
General Microbiology (MB 401-402)	4
Plant Physiology (BO 442)	4

Chemistry:

Organic Chemistry	4
Analytical Chemistry	4
Physical Chemistry	4
MA 201 Anal. Geometry & Calculus II	4
MA 202 Anal. Geometry & Calculus III	4
Chemistry Elective	4

Earth Science:

GY 222 Historical Geology	3
GY 208 Physical Geography and	
Meteorology	3
or	
GY 486 Weather & Climate	2
PY 223 Astronomy & Astrophysics	3
Earth Science Electives	15-16

Physics:

MA 201 Anal. Geom. & Calculus II	4
MA 202 Anal. Geom. & Calculus III	4
PY 223 Astronomy & Astrophysics	3
PY 407 Introduction to Modern Physics	3
Physics Electives	9-10

GRADUATE PROGRAM

The department offers the Master of Science or Master of Education and the Ph.D. degrees in mathematics education and in science education. Prospective applicants should consult the Graduate School Catalog.

PSYCHOLOGY

Clarence Poe Hall

Professor H. G. MILLER, Head of the Department

Professors: J. O. COOK, H. M. CORTER, D. W. DREWES, J. C. JOHNSON, S. E. NEWMAN, R. G. PEARSON; *Professor Emeritus:* K. L. BARKLEY; *Adjunct Professor:* R. M. CHAMBERS; *Associate Professors:* J. L. COLE, J. W. CUNNINGHAM, R. E. LUBOW, J. W. MAGILL; *Clinical Associate Professors:* R. B. DUKE, B. A. NORTON; *Adjunct Associate Professor:* GILBERT GOTTLIEB; *Research Associate Professor:* B. W. WESTBROOK; *Assistant Professors:* T. E. LEVERE, J. E. LUGINBUHL, J. L. WASIK; *Clinical Assistant Professor:* MARGARET N. UTLEY; *Visiting Assistant Professors:* T. D. GARDNER, E. F. MALESKI, RACHEL F. RAWLS; *Adjunct Assistant Professors:* BRENDA C. BALL, R. W. OPPENHEIM —

Courses in psychology are designed to promote a broad understanding of behavior as a science and to cultivate the skills which may be useful in dealing

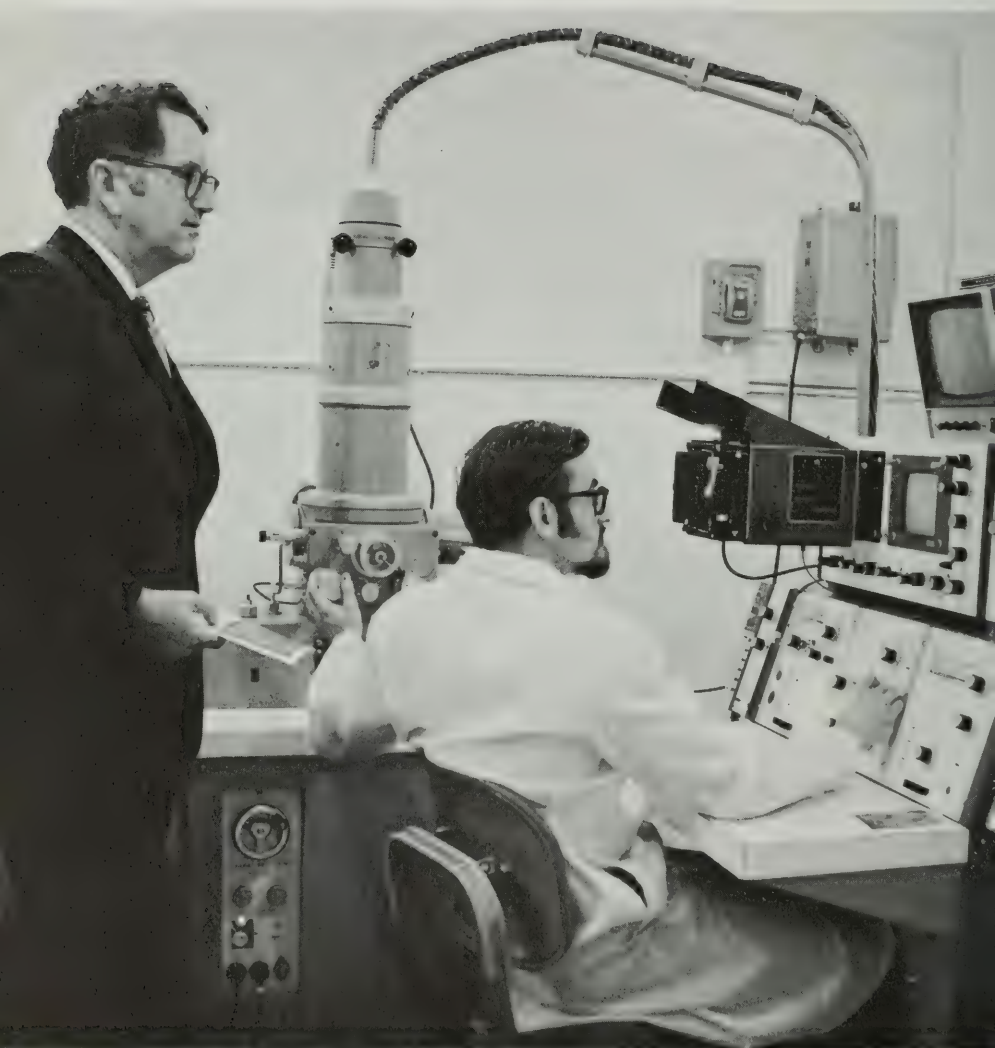
with human beings in social, educational, industrial or other situations. The department offers courses of interest to students in all schools of the University.

A major in psychology leading to the Bachelor of Arts degree is offered in the School of Education. The student is required to take 27 hours in psychology, plus a three-hour statistics course. Of the 27 hours in psychology, 21 are required, namely, Psychology 200, 210, 300, 310, 320 and the seminar series Psychology 491, 492. In addition, two elective courses in psychology at or above the 300 level are required.

In courses outside the major, the general requirements for arts degrees prevail except that the following courses are required for psychology majors: BS 100, MA 112, 212, 114 and a two-semester sequence in one of the physical sciences—physics or chemistry.

GRADUATE STUDY

The Department of Psychology offers the Master of Science and Doctor of Philosophy degrees. Prospective applicants should consult the Graduate School Catalog.



The electron scanning microscope is a useful facility for engineering research.

ENGINEERING

Riddick Hall

RALPH E. FADUM, *Dean*

ROBERT G. CARSON, JR., *Associate Dean for Academic Affairs*

HENRY B. SMITH, *Associate Dean for Graduate Studies and Research*

JOHN R. CANADA, *Assistant Dean for Extension*

The engineer has the responsibility and obligation to use knowledge in his field for the benefit of mankind. Today, a new sense of responsibility has been imposed upon the engineer by the impact of science and technology.

Engineering studies are important to those young men and women who look to industry, engineering education, or research and development for a career. These ambitions can well be furthered by the School of Engineering through its undergraduate or graduate programs, where students are offered technical instruction and leadership guidance by an experienced staff of qualified engineers and educators.

The School of Engineering is organized into 10 departments; biological and agricultural, chemical, civil, electrical, industrial, mechanical and aerospace, materials, nuclear, mechanics and research. Undergraduate degree programs are offered in the first nine departments listed. In addition, a degree in engineering operations is offered through a curriculum coordinator. All the teaching departments offer advanced studies leading to the professional degree, the master's degree and the Doctor of Philosophy degree.

A placement office is maintained by the University to assist graduating students and alumni with career development and associated problems.

It is the policy of the School of Engineering to have its curricula more than meet the standards of the Engineers' Council for Professional Development. It is the ambition of the school that these curricula and programs meet the needs of the people and industries of the state and region through effective instruction, competent research and development, and worthwhile contributions to engineering knowledge.

CURRICULA AND DEGREES

The freshman year of the studies is the same for all the engineering curricula. All entering students are assigned to the freshman engineering division where each student is given advice in planning an appropriate program of study. Although the entering student may indicate a curriculum choice if he has one, he may wait until the end of his first year when he is in a better position to judge which engineering branch of study is most suited to his own interests and talents.

Bachelor of Science in Engineering—The four-year program provides preparation for graduate school or to meet the needs of young people who will go into industry in the fields of design, development, production, sales, application, and planning and operation of industrial units.

The four-year curricula offer programs of study leading to a bachelor's degree in aerospace, biological and agricultural, ceramic, chemical, civil, electrical, engineering mechanics, engineering operations, industrial, mechanical, materials and nuclear engineering. Construction engineering is an option in civil engineering. Graduation requirements are the satisfactory completion of the electives and required courses in any one curriculum which amount to 125 to 130 semester hours. A minimum scholastic record of a "C" average is also required.

Specialized Degree—A specialized Bachelor of Science degree is also offered through a program of study in furniture manufacturing and management. This four-year curriculum is offered through the Department of Industrial Engineering.

Engineering Honors Program—The Engineering Honors Program is designed to challenge the talented student and to optimize the utilization of his and the University's resources. The features which distinguish the Engineering Honors Program from the standard B.S. program of study are 1) special Engineering Honors courses, 2) opportunities for independent study and original work, 3) complete freedom of course substitution with adviser's approval, and 4) free access to library stacks and other opportunities normally available only to graduate students. In addition, with the instructors' consent, the program offers the opportunity to take any required course in depth and, thus, receive Engineering Honors credit. For details of the program contact the dean's office.

Cooperative Education Program—A program of Cooperative Education was begun in the school year 1968-69 for the School of Engineering. The program, which is optional, is planned such that the student may alternate semesters of study with semesters of work during the sophomore and junior academic levels. The freshman and senior years are spent on campus while the sophomore and junior academic levels are spread over a three-year period to permit the sandwiching of the academic semesters with practical work experience semesters. The co-op plan requires five calendar years for completion during which time the student receives approximately 18 months of practical experience in his field. Students in all curricula in the School of Engineering may participate if they have a grade point average of 2.25 or better. After a student has been accepted, he is expected to maintain at least a 2.00 grade-point average to remain in good standing. Application for admission into the co-op program should be made early in the fall semester of the freshman year; however, later applications resulting in fewer work semesters prior to graduation will be considered. Further information may be obtained from the Director of Cooperative Engineering Education, 236 Riddick Building, School of Engineering.

Joint Liberal Arts-Engineering Program—Students may wish to take advantage of the opportunity to combine a B.S. in engineering with either a B.S. or B.A. in liberal arts. When the two are carried along together the double degree program can be completed in five years. Those interested should contact the Freshman Engineering Division and the Dean of Liberal Arts.

Professional Degree in a Specialized Branch of Engineering—The professional degree in a specialized branch of engineering is an earned degree which can be obtained after the bachelor's degree.

The curricula are especially designed to meet the needs of students desiring intensive specialization in a particular field or additional course work not ordinarily covered in the normal four-year undergraduate curricula. The professional program of study is offered in ceramic, chemical, civil, electrical, industrial, mechanical, materials and nuclear engineering.

For detailed information concerning the requirements for the professional degree, turn to pages 173-174.

GRADUATE STUDY

A master's degree in a specialized branch of engineering is offered. These are in electrical, mechanical, civil, engineering mechanics, and industrial engineering. The Master of Science and Doctor of Philosophy degrees are offered in all departments of the school. Prospective applicants should consult the Graduate School Catalog.

RESEARCH

Research activities in the School of Engineering are, in general, related to the educational purposes of graduate studies. A broad spectrum of research activities are engaged in by all departments of the school. The major purposes of these research activities are those of contributing to the scholarly activities of our faculty and training graduate students in research. It is intended that these scholarly and research activities be of such a caliber as to result in useful and publishable results.

The State of North Carolina provides research services in areas devoted toward greater utilization of the state's resources. This program is administered through the engineering research department.

The State of North Carolina also supports a research program at the Minerals Research Laboratory in Asheville, North Carolina. The main purposes of this program are those of assisting in the development of North Carolina's mineral industries. This program is operated by the School of Engineering, but it does not engage in extensive graduate research activities.

SHORT COURSES AND INSTITUTES

The School of Engineering offers approximately 100 short courses, conferences, workshops, seminars and institutes each year both on the campus and at various centers throughout the State for adults and graduate engineers. Such courses vary in length from periodic evening meetings to full-time endeavors of several weeks; each year the courses offered are different and vary according to the public demand. The engineering faculty usually furnish a large portion of the instruction offered in these courses.

These short courses offer real opportunity to practicing engineering personnel to follow a refresher program in their field of interest, as well as to become acquainted with the latest and most modern engineering procedures and equipment.

HUMANITIES AND SOCIAL SCIENCES

The educated engineer has a foundation in the humanities and social sciences as well as in his technical studies. Each student in the School of Engineering shall take a minimum of 18 credit hours of humanities and/or social science, approved by his adviser, made up as follows:

One beginning course in economics

One beginning course in literature, suggested courses are:

ENG 205 Reading for Discovery

ENG 262 English Literature II

ENG 266 American Literature II

One beginning course in history

One course in history and philosophy of science, suggested courses are:

HI 422 Rise of Modern Science

PHI 405 Philosophy of Science

SS 301 Science and Civilization

SS 302 Science and Contemporary Civilization

Two additional courses from the humanities-social sciences, suggested courses are:

ANT 252 Cultural Anthropology

ANT 305 Peoples of the World

EC 370 (HI 370) The Rise of Industrialism

EC 413 Competition, Monopoly, & Public Policy

EC 431 Labor Economics

EC 440 Economic Development

EC 448 International Economics
 EC 470 (HI 470) Evolution of the American Economy
 EC 475 Comparative Economic Systems
 EM 590 (PHI 590, REL 590) Technology and Human Values
 ENG 346 Comparative Literature I
 ENG 371 The Modern Novel
 ENG 398 Contemporary Literature I
 ENG 399 Contemporary Literature II
 ENG 468 American Romanticism
 ENG 485 Shakespeare
 GN 301 Genetics in Human Affairs
 History, any 300 or higher numbered course
 MUS 200 Music in Contemporary Life
 MUS 210 A Survey of Music in America
 MUS 220 Music of the Romantic Period
 PHI 305 Philosophy of Religion
 PHI 306 Philosophy of Art
 PHI 307 Morality and Human Happiness
 PHI 310 Existentialism
 PHI 406 Contemporary Political Philosophy
 PS 401 American Parties and Pressure Groups
 PS 472 Soviet Politics
 PS 473 Political Systems of New States
 REL 300 Introduction to Religion
 REL 321 Religion in American Life
 REL 327 Contemporary Religious Thought
 SS 301 Science and Civilization
 SS 302 Science and Contemporary Civilization
 SS 401 Contemporary Issues: The Urban Crises
 SS 402 Contemporary Issues: The Arms Race
 SOC 202 Principles of Sociology
 SOC 301 Human Behavior
 SOC 303 Current Social Problems
 SOC 304 Contemporary Family Life
 SOC 305 Race Relations
 UNI 303 Man and His Environment
 UNI 323 The World Population and Food Crisis

FRESHMAN ENGINEERING DIVISION

Riddick Hall

Associate Professor R. H. HAMMOND, Director

Instructors: J. L. CROW, G. A. FINLEY, J. F. FREEMAN, G. K. HILLIARD, JR., H. B. LUSK, E. H. STINSON, W. J. VANDER WALL, B. D. WEBB; Senior Adviser: B. HOUCK, JR.; Lecturer: D. L. KELLY

All students in their first year in the School of Engineering are required to take the same general program of courses as listed below. The Freshman Engineering Division of the school advises all freshman students on academic affairs and arranges a program of courses which best suits his individual background and talents and permits him the greatest probability of academic success. This division also offers basic counseling services to the freshman student.

Although an entering student may designate the department he proposes for his major, it is not necessary for him to decide upon his major until the end of his freshman year. Prior to the fall semester each student having earned 28 or

more credits is transferred to the department of his choice.

The Freshman Engineering Division offers assistance to high schools on any problems involving engineering as a career. However, its major function is guiding and counseling each student throughout his freshman year in the School of Engineering.

FRESHMAN YEAR IN ALL ENGINEERING CURRICULA

CH 101 General Chemistry I	4
CH 105 Chemistry—Principles and Applications*	3
E 101 Engineering Graphics I	2
E 120 Engineering Concepts	3
ENG 112H Composition and Reading**	3
Humanities or Social Science***	3
MA 102 Analytic Geometry and Calculus I	4
MA 201 Analytic Geometry and Calculus II	4
PY 205 General Physics	4
Physical Education	2
	<hr/> 32

* Those students who intend to major in Chemical Engineering or who expect to take additional chemistry courses will take CH 107, Principles of Chemistry instead of CH 105.

** If a grade of C or better is not achieved in ENG 112H an additional English course is required.

*** The Humanities or Social Sciences courses usually suggested are HI 105, Modern Western World or EC 205, Economic Activity.

The program above is shown only as a typical program. Other courses may be substituted, added, or deleted dependent upon each student's individual background and talents. Individual programs might range from 28 credits to 35 credits.

BIOLOGICAL AND AGRICULTURAL ENGINEERING

(Also see Agriculture and Life Sciences)

David S. Weaver Laboratories

Professor F. J. HASSLER, Head of the Department

TEACHING AND RESEARCH

Professors: H. D. BOWEN, J. M. FORE, D. H. HOWELLS, W. H. JOHNSON, C. W. SUGGS; Professor Emeritus: J. W. WEAVER, JR.; Associate Professors: G. B. BLUM, JR., J. W. DICKENS (USDA), E. L. HOWELL, B. K. HUANG, E. G. HUMPHRIES, W. F. MCCLURE, C. R. WILLEY (USDA), R. E. WILLIAMSON (USDA), E. H. WISER, J. H. YOUNG; Assistant Professors: J. R. HAMMERLE, R. G. HOLMES, F. J. HUMENIK, R. P. ROHRBACH, R. W. SKAGGS, R. S. SOWELL, T. B. WHITAKER (USDA); Assistant Professor Emeritus: N. W. WELDON; Associate Members of the Faculty: D. D. HAMANN, V. A. JONES (Food Science)

EXTENSION

Associate Professor G. J. KRIZ, Associate Head in Charge of Extension

Professor Emeritus: H. M. ELLIS; Associate Professors: L. B. DRIGGERS, W. C. WARRICK; Associate Professor Emeritus: J. C. FERGUSON; Assistant Professors: E. O. BEASLEY, J. W. GLOVER, R. W. WATKINS; Instructor: R. E. SNEED

Students in biological and agricultural engineering are educated and trained to deal with problems of agriculture that are engineering in nature. Involved are

the application of scientific and engineering principles to the conservation and utilization of water and soil, the development of power and labor-saving devices for all phases of agricultural production, the design of structures and equipment for housing and handling livestock and field products, and the processing and marketing of farm products.

UNDERGRADUATE CURRICULUM

This curriculum, offered in conjunction with the School of Agriculture and Life Sciences, is designed to develop young men capable of engineering leadership in agriculture. Emphasis is placed on basic science courses such as mathematics, physics, mechanics, biology, soils and thermodynamics, which provide a sound background for engineering and agricultural technology. Courses in biological and agricultural engineering are directed to those methods of thought and techniques whereby science can be applied with understanding and judgment to engineering situations in agricultural operations. General agriculture courses are provided in order that the student can better understand the agricultural industry with which he deals.

Since training in biological and agricultural engineering involves two distinct technical fields—agriculture and engineering—this curriculum is a joint responsibility of the two schools and is so administered.

FACILITIES

The Department of Biological and Agricultural Engineering is housed in the David S. Weaver Laboratories. This complex of buildings, completed in 1970, embodies the most advanced facilities for education and research in the application of engineering to the production and processing of biological material for food and fiber. Included are offices, classrooms, laboratories, shop facilities and space for the Agricultural Engineering Extension Service.

OPPORTUNITIES

Men trained in biological and agricultural engineering are qualified for positions in design, development and research in public institutions and in industry, and for teaching and extension work in institutions of higher education. The curriculum also provides adequate training for postgraduate work leading to advanced degrees. Graduates in this program receive the degree of Bachelor of Science in biological and agricultural engineering.

BIOLOGICAL AND AGRICULTURAL ENGINEERING CURRICULUM

For the freshman year see page 147.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BAE 251 Elements of Bio. & Agr. Engr.	3	BS 100 General Biology	4
CSC 111 Algorithmic Lang. I.	2	EE 331 Princ. of Elect. Engr.	3
EM 205 Prin. of Engr. Mech.	3	EM 305 Engineering Dynamics	3
MA 202 Analytic Geometry and		Humanities & SS	3
Calculus III	4	MA 301 Applied Differential Equations I . . .	3
PY 208 General Physics	4	Physical Education	1
Physical Education	1		
	17		17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BAE 361 Analytical Methods	3	BAE 342 Agr. Processing	4
BAE 391 Electrotechnology in Bio. & Agr. Engr.	3	BAE 381 Agr. Structures & Env.	3
EM 301 Solid Mechanics I	3	BAE 462 Functional Design of Field Mach.	3
MAE 301 Engr. Thermodynamics I	3	Humanities & SS	3
SSC 200 Soils	4	Free Elective	3
	<hr/> 16		<hr/> 16

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BAE 451 Agr. Engr. Design I	3	BAE 452 Agr. Engr. Design II	3
BAE 472 Agr. Water Management	4	Advised Tech. Elec.	3
Humanities & SS	6	Humanities & SS	6
Free Elective	3	Free Elective	3
	<hr/> 16		<hr/> 16

Total Hours—129

Humanities and social sciences will be taken according to the standard engineering school listing.

GRADUATE STUDY

The department offers programs of study for the Master of Science, Doctor of Philosophy and Master of Biological and Agricultural Engineering degrees. Prospective applicants should consult the Graduate School Catalog.

CHEMICAL ENGINEERING

Riddick Hall

Professor J. K. FERRELL, Head of the Department

Professors: K. O. BEATTY, JR., W. L. MCCABE, E. M. SCHOENBORN, JR., V. T. STANNETT; Professor Emeritus: R. BRIGHT; Adjunct Professors: H. P. KRAMER, D. M. PREISS, D. R. SQUIRE; Associate Professors: R. P. GARDNER, H. B. HOFFENBERG, D. B. MARSLAND, D. C. MARTIN, J. F. SEELY, E. P. STAHEL; Assistant Professors: R. M. FELDER, R. W. ROUSSEAU

Chemical engineering is concerned with the design, optimization and control of processes, equipment and plants in which chemical and physical transformations of matter are carried out. Typical industries relying heavily upon chemical engineering include those producing chemicals, polymers, synthetic fibers, metals, drugs, glass, food, gasoline, rocket fuels, paper, soap and cement; those producing energy from nuclear fuels; and those processing materials by methods involving chemical reactions. The preparation of men qualified to pursue careers in such industries as these is the purpose of the curriculum in chemical engineering.

CURRICULUM

The work of the chemical engineer is extremely diversified and consequently his education must be along broad and basic lines. The spirit of research and experimentation is a vital part of the chemical industry and even those in the undergraduate curriculum need to acquire the sound scientific background essential to original thought and independent accomplishment. The undergraduate curriculum emphasizes the engineering, chemical and economic principles involved in chemical processes and operations. The work in chemistry including inorganic,

analytical, physical and organic chemistry is comparable to that usually given to chemists with the exception of a reduction of time devoted to laboratory work. The subjects in mechanics and materials are designed to supply the fundamentals of these branches. The work in the chemical engineering subjects, although distinctly professional in application, is nevertheless basic in character. Since it depends upon a thorough background in mathematics and the sciences, it is postponed until the third and fourth years. It is designed to develop initiative, sound habits of thought and intellectual curiosity in the student.

Chemical engineers have played a major role in the atomic energy field. The future of production of nuclear fuels, the operation and design of reactors, and the processing of irradiated materials present a multitude of chemical engineering problems. New demands require increasing application of chemical engineering principles to the development of new and unique materials for special applications, new chemical processes for air and water pollution abatement, and new materials such as fuels, propellants, heat shields and fuel cells.

FACILITIES

The chemical engineering laboratories are provided with pilot plant-type equipment for studying the principles of fluid flow, heat transfer, distillation, absorption, drying, crushing and grinding, filtration, chemical reaction kinetics, etc. Much new equipment has been installed and new and special apparatus is added from time to time to keep the facilities abreast of recent developments in the field. Emphasis is placed on the use of both digital and analog computers in the solution of typical chemical engineering problems. Special equipment for research and instructional purposes is designed and built in the departmental laboratories. In this way students are given first-hand acquaintance with problems relating to the actual design, construction and operation of typical equipment used in industry.

OPPORTUNITIES

Opportunities for employment in the chemical, atomic energy and allied fields upon graduation are numerous and varied. Graduates find employment in such fields as research and development; production, operation and maintenance; management and administration; inspection, testing and process control; technical service and sales; estimation and specification writing; consulting and teaching, and many others. Students desiring to pursue careers in research and development or in teaching and consulting work are strongly advised to consider graduate training. In fact, the need for persons who have had advanced training in the field beyond the regular four-year program is continually increasing.

CHEMICAL ENGINEERING CURRICULUM

For the freshman year see page 147.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I	4	CH 223 Organic Chemistry II	4
CHE 205 Chemical Process Princ.	3	CHE 225 Chemical Proc. Systems	3
CSC 111 Algorithmic Languages I	2	EM 205 Princs. of Engr. Mechs.	3
MA 202 Analytic Geometry		Humanities and Social Sciences	3
and Calculus III	4	MA 301 Applied Differential Equations I ..	3
PY 208 General Physics	4	Physical Education	1
Physical Education	1		
	<hr/> 18		<hr/> 17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 431 Physical Chemistry I	3	CHE 315 Chem. Proc. Thermodynamics	3
CH 432 Physical Chemistry I Lab.	1	CHE 327 Separation Processes I	3
CHE 311 Transport Processes I	3	CHE 431 Chemical Engr. Lab. I	3
Humanities and Social Sciences	3	Chemistry Elective	3
MAT 201 Structure and Properties of		Humanities and Social Sciences	3
Engr. Materials I	3		15
Free Elective	3		
	16		

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CHE 316 Thermodynamics of Chem.		CHE 451 Chem. Engr. Design	3
and Phase Equilibria	3	Humanities and Social Sciences	3
CHE 432 Chemical Engr. Lab. II	3	Technical Elective	3
CHE 495 Seminar	1	Free Elective	6
CHE 446 Chemical Process Kinetics	3		15
Humanities and Social Sciences	3		
Technical Elective	3		
	16		

Total Hours—130

CIVIL ENGINEERING

Mann Hall

Professor D. L. DEAN, Head of the Department

Professor PAUL Z. ZIA, Associate Head of the Department

Professor C. SMALLWOOD, JR., Graduate Administrator

Professors: M. AMEIN, W. F. BABCOCK, C. R. BRAMER, P. D. CRIBBINS, R. E. FADUM, C. L. HEIMBACH, J. W. HORN, A. I. KASHEF, W. G. MULLEN, M. E. UYANIK, H. E. WAHLS; Adjunct Professor: C. L. MANN, JR.; Associate Professors: J. F. ELY, W. S. GALLER, K. S. HAVNER, L. J. LANGFELDER, J. F. MIRZA, G. R. TAYLOR, C. C. TUNG; Adjunct Associate Professor: C. P. FISHER, JR.; Assistant Professors: N. V. COLSTON, JR., W. J. HEAD, F. J. HUMENIK, J. L. MACHEMEHL, J. C. SMITH; Extension Specialist: R. F. DEBRUHL; Environmental Extension Specialist: D. R. JOHNSTON

Civil engineering is one of the broadest of the various fields of engineering. It deals with the planning, design and construction of buildings, dams, bridges, harbor works, water works, water power facilities, sewage disposal works, nuclear waste facilities, missile launch facilities and transportation facilities including highways, railways, waterways, airports and pipe lines. Graduates in civil engineering are in demand by public agencies as well as by private enterprise. The activities of the civil engineer are such that opportunities are available for office-type as well as field-type employment and for employment in small communities as well as in large industrial centers.

OBJECTIVES

It is the primary mission of the Department of Civil Engineering to offer programs of study designed to provide adequate academic preparation to those contemplating a career in the civil engineering profession. To this end, course work at both the baccalaureate and the graduate levels is offered. The undergraduate program is designed to provide a sound general education and at the same time to prepare the student for advanced study in engineering either by the continuation of formal education at the graduate level or by self-study.

FACILITIES

The Department of Civil Engineering is located in Mann Hall. This building provides offices, drafting rooms and classrooms, as well as laboratory facilities the continuation of formal education at the graduate level or by self-study. for testing structural materials, large models or full-scale structures, soils and bituminous products, for hydraulic experiments, for studies in airphoto interpretation and photogrammetry, for analysis of small structural models, for chemical and biological tests pertaining to sanitary engineering, and for the investigation of transportation problems. In addition the facilities of Mann Hall include a student lounge, a computation and cardpunch room, and a departmental library. All of these facilities have been designed to provide for effective teaching and laboratory instruction and to create a scholarly environment.

UNDERGRADUATE CURRICULA

The Department of Civil Engineering offers two four-year undergraduate curricula: the one, leading to the degree of Bachelor of Science in civil engineering; the other, to the degree of Bachelor of Science in civil engineering, construction option. Both of these curricula have been accredited by the Engineers' Council for Professional Development.

The civil engineering curriculum is a well-balanced program of study providing academic discipline in the pure and applied physical sciences, the humanities and social sciences, and the professional aspects of civil engineering including structural, transportation and sanitary engineering, and soil mechanics and foundations.

The curriculum in civil engineering construction option is designed to suit the needs of students who are especially interested in the construction phases of civil engineering. It includes the core course requirements in the physical sciences and the social sciences and humanities as established for all engineering curricula at North Carolina State University. It differs from the civil engineering curriculum in that special emphasis is given to the construction aspects of civil engineering. To this end, the curriculum includes a four-semester sequence of courses in estimates and costs and construction planning and organization. The courses unique to this curriculum are designed to provide academic discipline in the engineering, planning and management aspects of construction.

CIVIL ENGINEERING CURRICULUM

For the freshman year see page 147.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 202 Intro. to C.E.	2	EM 301 Solid Mech. I	3
EM 200 Intro. to Mechanics	3	GY 120 Physical Geology	3
Hum. and Soc. Sci.*	3	Hum. and Soc. Sci.*	3
MA 202 Anal. Geom. & Cal. III	4	MA 301 Applied Diff. Equations I	3
PY 208 General Physics	4	MAT 200 Mech. Prop. of Stru. Materials ..	2
Physical Education	1	Free Elective	3
	17	Physical Education	1
			18

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 301 Engr. Surveying	3	CE 305 Transp. Engr. I	4
CE 382 Hydraulics	4	CE 326 Struct. Engr. I	4
CE 332 Matls. of Constr.	3	CE 342 Soil Engineering I	4
CE 382 Hydraulics	3	CE 383 Water Res. Engr. I	4
IE 311 Engr. Project Analysis ..	3		
	16		16

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Civil Engineering Electives**	6	CE 450 Civil Engr. Design	3
Engr. Science Elec.**	3	Civil Engr. Elective	3
Hum. and Soc. Sci.*	3	Hum. and Soc. Sci.*	6
Free Elective	3	Free Elective	3
	<u>15</u>		<u>15</u>

* Humanities and Social Science courses to be selected from the standard school pattern.

** Two courses selected from

CE 406 Transp. Engr. II
CE 427 Struct. Engr. II
CE 443 Soil Engineering II
CE 484 Water Res. Engr. II

*** Thermodynamics, engineering mechanics, electrical engineering or materials engineering.

Total Hours—129

CONSTRUCTION OPTION CURRICULUM

For the freshman year see page 147.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 202 Intro. to C. E.	2	GY 120 Physical Geology	3
MA 202 Anal. Geom. & Cal. III	4	MAT 200 Mech. Prop. of Str. Materials	2
PY 208 General Physics	4	EM 301 Solid Mechanics I	3
EM 200 Intro. to Mechanics	3	MA 301 Diff. Equations	3
Hum. and Soc. Sci.*	3	Hum. and Soc. Sci.*	3
Physical Education	1	Free Elective	3
	<u>17</u>	Physical Education	1
			<u>18</u>

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 301 Engr. Surveying	3	CE 305 Transport. Engr. I	
CE 325 Structural Analysis	3	or	
CE 332 Mats. of Constr.	3	CE 383 Water Res. Engr. I	4
CE 382 Hydraulics	4	CE 326 Structural Engr. I	4
IE 311 Engineering Project Analysis	3	CE 342 Soil Engineering I	4
	<u>16</u>	CE 365 Construction Engr. I	4
			<u>16</u>

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 463 Cost Analysis and Control	3	CE 460 Construction Engr. Project	3
CE 466 Construction Engr. II	3	CE 464 Legal Aspects of Contracting	3
Engr. Science Elec.**	3	Hum. and Soc. Sci.*	6
Hum. and Soc. Sci.*	3	Free Elective	3
Free Elective	3		<u>15</u>
	<u>15</u>		

Total Hours—129

* Humanities and Social Science courses to be selected from standard school pattern.

** Thermodynamics, engineering mechanics, electrical engineering or materials engineering.

PROFESSIONAL STUDY IN CIVIL ENGINEERING

Fifth-year programs of study leading to the professional degree of Civil Engineer are offered in the following specialty fields: sanitary engineering, soil mechanics and foundation engineering, structural engineering, and transportation engineering. The fifth-year curricula, which are made up of advanced course work, are offered as a continuation of the four-year undergraduate program and are designed for students who are desirous of becoming technically proficient in one of the specialty fields of civil engineering. The following curricula are

illustrative of the fifth-year program of study. It is to be understood, however, that a curriculum for a given student is designed in consultation with his adviser to suit his particular interests.

Regulations governing the professional program are shown on pages 173-174.

SANITARY ENGINEERING

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 571 Theory of Water & Waste Treatment	3	CE 572 Unit Operations & Processes in Wastes Engineering	3
CE 573 Analysis of Water & Wastes	3	CE 598 Civil Engineering Projects	2
CE 598 Civil Engineering Projects	2	CE 672 Advanced Water & Wastes Treatment	4
CE 671 Advanced Water Supply & Waste Water Disposal	4	Electives	6
Elective	3		15
	15		

SOIL MECHANICS AND FOUNDATION ENGINEERING

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 524 Analysis & Design of Masonry Structures	3	CE 544 Foundation Engineering	3
CE 525 Advanced Structural Analysis I	3	CE 549 Engineering Properties of Soils II	3
CE 548 Engineering Properties of Soils I	3	CE 642 Advanced Soil Mechanics	3
CE 641 Advanced Soil Mechanics	3	MA 405 Introduction to Matrices and Linear Transformations	3
Electives	3	Elective	3
	15		15

STRUCTURAL ENGINEERING

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 525 Advanced Structural Analysis I	3	CE 526 Advanced Structural Analysis II	3
CE 625 Advanced Structural Design I	3	CE 544 Foundation Engineering	3
EM 551 Advanced Strength of Materials	3	CE 626 Advanced Structural Design II	3
MA 405 Introduction to Matrices and Linear Transformations	3	EM 552 Elastic Stability	3
Elective	3	Elective	3
	15		15

TRANSPORTATION ENGINEERING

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CE 515 Transportation Operations	3	CE 516 Transportation Design	3
CE 517 Water Transportation	3	CE 601 Transportation Planning	3
CE 603 Airport Planning & Design	3	CE 604 Urban Transportation Planning	3
Electives	6	Electives	6
	15		15

GRADUATE STUDY

The graduate degrees offered by the civil engineering department are the Master of Civil Engineering, the Master of Science in civil engineering and the Doctor of Philosophy. Prospective applicants should consult the Graduate School Catalog.

POST-BACCALAUREATE STUDY IN CIVIL ENGINEERING RELATED TO OTHER FIELDS

Transportation Engineering and City and Regional Planning—There exists a growing need for the coordination of transportation facilities and land planning and for individuals with competence in both fields. To fulfill this need, an advanced program leading to a post-baccalaureate degree in engineering with a major in transportation engineering, and to the degree of Master of Regional Planning is offered through the combined resources of the Department of Civil Engineering at North Carolina State University and the Department of City and Regional Planning at the University of North Carolina at Chapel Hill. Qualified students have the opportunity to schedule their courses of instruction to enable

them to pursue the dual degree.

The program is designed for students who are desirous of becoming technically proficient in both the fields of transportation engineering and city and regional planning. The minimum residence requirements include two academic years plus a summer internship. The curriculum includes the major core courses for both the advanced transportation engineering program and the city and regional planning program, plus supplementary courses important to both endeavors and a thesis. A bachelor's degree in engineering, including a knowledge of transportation engineering, from an institution of recognized standing is required for admission to the program. Applicants who do not meet these requirements in full may submit their credentials for examination and consideration.

Further information concerning the joint program may be obtained from the Department of Civil Engineering at North Carolina State University or from the Department of City and Regional Planning at the University of North Carolina at Chapel Hill.

Water Resources—To meet the need by industry for personnel with training in water supply and the abatement of water pollution, students in the many curricula leading to positions in industry (food processing, textile chemistry, pulp and paper technology, chemical engineering, zoology and others) may consider courses of instruction in sanitary engineering for advanced undergraduate electives and for minor sequences for advanced degrees. Among the courses appropriate for such students are the following: CE 484, Water Resources Engineering II; CE 571, Theory of Water and Waste Treatment; CE 573, Analysis of Water and Wastes; CE 673, Industrial Water Supply and Waste Disposal; CE 674, Stream Sanitation.

In addition to the traditional program in water supply and pollution control, it is possible for students to major in the areas of hydraulics and hydrology. These programs are developed in conjunction with the engineering mechanics and agricultural engineering programs. Further information may be obtained by writing to the Department of Civil Engineering.

ELECTRICAL ENGINEERING

Daniels Hall

Professor G. B. HOADLEY, Head of the Department

Professor W. D. STEVENSON, JR., Associate Head of the Department

Assistant Professor W. P. SEAGRAVES, Undergraduate Administrator

Professors: W. J. BARCLAY, A. R. ECKELS, W. A. FLOOD, D. R. RHODES, J. STAUDHAMMER, F. J. TISCHER; Adjunct Professors: G. K. MEGLA, CARMEN J. PALERMO; Professor Emeritus: A. M. FOUNTAIN; Associate Professors: N. R. BELL, A. J. GOETZE, J. R. HAUSER, M. A. LITTLEJOHN, E. G. MANNING, N. F. J. MATTHEWS, L. K. MONTEITH, J. B. O'NEAL, JR., W. C. PETERSON; Adjunct Associate Professors: E. CHRISTIAN, J. J. WORTMAN; Visiting Associate Professor: Y. N. PATT; Associate Professor Emeritus: E. W. WINKLER; Assistant Professors: W. T. EASTER, J. W. GAULT, T. H. GLISSON, L. R. HERMAN, R. W. STROH; Adjunct Assistant Professor: C. C. TAPPERT; Instructors: G. G. REEVES, A. T. SHANKLE, M. G. ZAALOUK

The purpose of the undergraduate curriculum is to train young people, either for active work in a challenging and diversified field or for further study on the graduate level. To achieve this a thorough grounding is given in engineering science, followed by a solid foundation in fundamental electrical theory, and by advanced subject matter of sufficient breadth to insure adequate preparation for

a dynamic profession. This background is essential for success, whether the particular field be antennas, radio propagation, automatic control, computers, communications, telemetering, electronics, the design of electrical equipment, the manufacture of electrical equipment, electrical power production, the utilization of electric power, electronics in medicine, instrumentation, solid-state devices or any other one of the vital, fast developing fields using electricity as either muscles or nerves.

CURRICULUM

The curriculum in electrical engineering includes comprehensive training in mathematics and physics—the fundamental sciences—and adequate training in allied branches of engineering. Most courses are accompanied by coordinated work in the laboratory and drill in the application of theory by means of carefully planned problems.

Each student has a choice of elective courses in his program. This allows the student to direct his program to suit his own individual and special needs and interests. Students who may be qualified for graduate study have an even wider choice and may coordinate their senior year with a plan for graduate study later. Near the end of the sophomore year, each student is asked to consider his electives and to plan a coordinated program of courses suited to his particular needs and interests.

Examinations are given each week to sophomore students in the electrical engineering course. In the junior year, examinations are given every three weeks; and in the senior year, they are given about every five weeks. This decreasing frequency of examinations is intended to encourage the student to assume more and more responsibility for the success of his own program.

FACILITIES

The Department of Electrical Engineering is housed in Daniels Hall. In addition to offices and classrooms this building provides laboratories for the study of servomechanisms and control, electronics and communications, circuits, instrumentation, computers, microwaves, antennas, electromagnetic fields and waves, electric filters and electrical machinery. There are also a student study room, a shop and a number of research laboratories, especially in semiconductor materials and devices, and in electromagnetics.

Also available to the student are the services of a digital computer.

GRADUATION REQUIREMENTS

Requirements for graduation are passing grades in the courses listed in the electrical engineering curriculum, passing of 124 credit hours and a grade-point average of 2.00 or better.

Attendance at two professional electrical engineering society meetings, one in the junior year and one in the senior year, is required.

Also a minimum of six continuous weeks of gainful employment is required. This employment may be as laborer, subprofessional or professional assistant in any of the following fields: industrial manufacturing, repair service or sales; industrial engineering; scientific research; engineering or architectural design and drafting; engineering exploration, surveying or reconnaissance; construction of engineering works. Technical work while in military service or for a school does not satisfy this requirement. The student is responsible for obtaining his employment and supplying satisfactory evidence thereof to the department. This evidence will consist of a letter from the employer to the undergraduate administrator setting forth inclusive dates of employment, character of work performed and an evaluation of the student's work.

STUDENT ACTIVITIES

Close coordination with the work of the professional electrical engineering societies is maintained through the IEEE Student Branch which meets monthly. Faculty advisers assist the student in bringing to these meetings practicing engineers. The Student Branch also sponsors departmental activities such as an annual student papers contest and departmental participation in the engineers' fair.

An active chapter of Eta Kappa Nu, the national honorary electrical engineering fraternity, undertakes numerous important projects in addition to holding two initiation banquets yearly.

ELECTRICAL ENGINEERING CURRICULUM

For the freshman year see page 147.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EE 201 Electric Circuits I	4	EE 202 Electric Circuits II	4
Humanities & Soc. Stud.*	3	EM 205 Prin. Engr. Mechanics	3
MA 202 Anal. Geom. and Calc. III	4	Humanities & Soc. Stud.*	3
PY 208 General Physics	4	MA 301 Applied Diff. Equations I	3
Physical Education	1	Physical Education	1
	<hr/> 16		<hr/> 14

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EE 303 Electromag. Fields I	3	EE 304 Electromag. Fields II	3
EE 314 Electronic Circuits	4	EE 305 Electromechanical Syst.	4
EM 301 Solid Mechanics I		EE 401 Advanced Elec. Cir.	3
or		Humanities & Soc. Stud.*	3
EM 303 Fluid Mechanics I	3	Free Elective	3
Humanities & Soc. Stud.*	3		<hr/> 16
Free Elec. or Humanities*	3		
	<hr/> 16		

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EE 440 Fund. of Digital Syst.	3	ENG 321S The Comm. of Tech. Info.	3
Departmental Elective**	3	Departmental Elective**	3
Humanities & Soc. Stud.*	3	Humanities & Soc. Stud.*	3
MA, PY or ST Elective	3	MAE 301 Engr. Thermodynamics I	3
Free Elective	3	Free Elective	3
	<hr/> 15		<hr/> 15
Total Hours—124			

* A total of 21 hours in the humanities and social sciences, including either SS 401 or SS 401, is required. The other hours will be according to the standard school program.

** Chosen from an approved list of EE 400- and 500-level course sequences.

PROFESSIONAL DEGREE

A fifth or professional year of study is offered in electrical engineering as a continuation of the four-year undergraduate program. This fifth year of study offers specialized and advanced course work leading to the degree of Electrical Engineer. Each student taking this fifth year work plans his program of courses to meet his individual needs. Regulations governing the professional degree are shown on pages 173-174.

GRADUATE STUDY

The department offers the Master of Science, the Master of Electrical Engineering, and the Doctor of Philosophy degrees. Prospective applicants should consult the Graduate School Catalog.

ENGINEERING MECHANICS

Riddick Hall

Professor P. H. McDONALD, JR., Head of the Department

Professor R. A. DOUGLAS, Associate Head of the Department

Professors: T. S. CHANG, J. A. EDWARDS; Professor Emeritus: A. MITCHELL; Associate Professors: W. L. BINGHAM, M. H. CLAYTON, J. F. ELY, E. D. GURLEY, E. G. HUMPHRIES, C. J. MADAY, F. Y. SORRELL, JR.; Assistant Professors: C. M. CHANG, R. P. GOGOLEWSKI, T. E. SMITH, JR.; Visiting Assistant Professor: Y. HORIE; Instructors: S. T. LEW, R. M. SEXTON; Extension Specialist: H. M. ECKERLIN

In the contemporary world there is clear need for persons well founded in the disciplines of engineering and science, with technical abilities developed deliberately to analyze and synthesize the complex systems characteristic of our age. At the same time, we recognize the responsibility that the educations of these persons must prepare them, as well, to undertake engineering works in a way mindful of the larger consequences of those works to the economy, to the environment and to the framework of society itself. And we recognize that the individual student should have the opportunity to build a program of studies reflecting his own interests and aspirations.

In the face of these requirements, the faculty of this department have developed a new curriculum that is expected to be more successful in addressing those sometimes conflicting needs than were the highly structured curricula of the past.

At the heart of the curriculum are courses in the engineering sciences, courses treating subjects expected to be as viable to engineering practice in the year 2000 as now. To insure the opportunity for individual development in both an engineering sense and a broader sense, the curriculum has been made very flexible through the introduction of a large number of electives. Each student is encouraged and aided in developing a program most suited to his own needs and desires while carefully planned sequences of electives insure that strength of total program is not sacrificed to momentary interest.

Graduates of this program in the engineering sciences will discover vistas of professional opportunity perhaps unmatched. Graduates may look to careers in management, in government, in applied research and development or in fundamental engineering research. Further, those who wish to pursue their formal educations to the master and doctoral levels will find that this program provides a particularly sound basis for the advanced studies offered in this department.

CURRICULUM

The undergraduate curriculum involves study of the behavior of particles and systems of rigid and deformable solids. It treats fluids, the microscopic and macroscopic behavior of materials, thermodynamics and transport phenomena. Supporting courses introduce electromagnetic circuits and electronics in addition to establishing a strong foundation in mathematics, classical and modern physics, chemistry, and humanities and social studies.

For the senior year, this broad program is topped off by any unusual group of synthesis courses in which the student conducts independent studies of his choice in real engineering systems bearing high relevance to the profession and to society.

LABORATORY FACILITIES

This department is located in the Riddick Laboratories Building. The department has its own precision machine shop in which to make the new devices called for by students in their independent research.

The departmental laboratories have become unique in the Southeast for the ultramodern facilities and instrumentation used to demonstrate, explain and explore the phenomena of engineering interest and study.

One example is a hypervelocity gun, capable of accelerating projectiles to velocities near five miles per second, used to study the impact of particles in space. Another is an electromagnetically driven linear pinch device for producing high temperature plasma flows in the Mach₁₀ to Mach₂₀₀ level.

Emphasis is placed on modern instrumentation and the use of such devices as accelerometers, hot wire anemometers, pressure probes, strain gages and associated recording equipment. Interferometry and birefringence, and other optical techniques are used for study of the behavior of solids, fluids and plasmas. The laboratories are equipped with the latest models of pulsed and continuous wave lasers as well as the most modern ultra high speed cameras capable of "freezing" impact phenomena in solids and shock wave radiation phenomena in plasmas.

ENGINEERING MECHANICS CURRICULUM

For the freshman year see page 147.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EE 201 Electrical Circuits I	4	EM 305 Engineering Dynamics	3
EM 205 Principles of Engineering Mechanics	3	Humanities and Social Science**	3
EM 206 Introductory Applications in Mechanics	1	MA 301 Applied Differential Equations I ..	3
MA 202 Analytic Geometry and Calculus III	4	MAT 201 Structure and Properties of Engineering Materials I	3
PY 206 General Physics	4	PY 207 General Physics	4
Physical Education	1	Physical Education	1
	17		17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EM 303 Fluid Mechanics I	3	Humanities and Social Science**	3
EM 307 Mechanics of Solids	3	Tech. Elective (Stem A)*	3
EM 311 Exp. Engineering Science I	3	Tech. Elective (Stem B)*	3
Humanities and Social Science**	3	Tech. Elective (Stem C)*	3
MA 401 Appl. Differential Equations II ..	3	Free Elective	3
	15		15

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EM 411 Engineering Cybernetics I	3	EM 412 Engineering Cybernetics II	3
Humanities and Social Science**	3	EM 415 Engineering Science in Contemporary Design	2
Tech. Elective (Stem A)*	3	Humanities and Social Science**	3
Tech. Elective (Stem B)*	3	Free Elective	6
Tech. Elective (Stem C)*	3		14
	15		

Total Hours—125

* Technical Elective Stems:

These courses will be selected in consultation with the adviser, from several broad interdepartmental groups, according to the individual student's educational objectives. The grouped subject areas include

Stem A: Fluid mechanics, thermodynamics, heat and mass transfer.

Stem B: Solid mechanics, dynamics, materials.

Stem C: General, such as: mathematics, electronics, electromagnetics, systems, structures, biomechanics, geosciences.

** See pages 145-146 for information about the humanities and social science sequence.

GRADUATE STUDY

The Department of Engineering Mechanics offers the Master of Engineering Mechanics degree, the Master of Science degree, and the Doctor of Philosophy degree. Prospective applicants should consult the Graduate School Catalog.

ENGINEERING OPERATIONS

Riddick Hall

Assistant Professor W. T. EASTER, Director

An Advisory Committee, made up of representatives from engineering departments concerned, serves to set overall policies for the curriculum, which is administered by the director.

The Bachelor of Science program in engineering operations is designed for students with talents and motivations in the directions of the engineering functions of production, plant operations, technical sales and the other activities needed to support the modern-day economy in an industrial society. The program has the same freshman year as other engineering curricula, the same humanities-social science stem included in other engineering programs, a grounding in the basic engineering sciences and a specialization sequence. The specialization sequence consists of 18 semester hours spread over the junior and senior years. The student need not make a choice of his specialization sequence until his junior year. Three sequences—ceramics, production and electrical—are available. Additional sequences may be developed in other areas from time to time.

Since this program is directed more toward industrial production and operations than some of the other engineering programs, it includes more courses on economics, materials, processes and manufacturing controls. The student is to choose one of the technical elective sequences listed on page 161.

ENGINEERING OPERATIONS CURRICULUM

For the freshman year see page 147.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EM 211 Introduction to Applied Mechanics	3	CSC 111 Algorithmic Languages I	2
Humanities or Social Science	3	E 207 Engineering Graphics III	2
MA 202 Analytic Geometry & Calculus III	4	EM 212 Mechanics of Engineering Materials	3
PY 212 General Physics	4	Humanities or Social Science	3
Physical Education	1	MAT 201 Structures & Properties of Engr. Materials I	3
	15	Physical Education	1
			14

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EC 206 The Price System or		EC 312 Accounting I	3
EC 426 Personnel Management	3	IE 301 Engineering Economy	3
EE 350 Electric Power Utilization in Manufacturing Processes	3	MAE 307 Energy and Energy Transformations	3
Humanities or Social Science	3		9
IE 328 Manufacturing Processes	3		
ST 361 Introduction to Statistics for Engineers I	3		
	15		

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanities or Social Science	3	Humanities or Social Science	3
EC 409 Introduction to Production Cost ...	3	IE 420 Manufacturing Controls	3
EO 491 Seminar	1		
	<u>7</u>		<u>6</u>

TOTAL CREDIT REQUIREMENTS

	<i>Industrial Ceramics</i>	<i>Production</i>	<i>Electrical</i>
Basic Curriculum Requirements	98	98	95
Free Electives	12	11	12
Technical Sequence	18	19	18
Hours Required for Graduation	128	128	125

TECHNICAL ELECTIVE SEQUENCE

<i>Junior Year</i>	<i>F</i>	<i>S</i>		<i>Senior Year</i>	<i>F</i>	<i>S</i>
1. <i>Industrial Ceramics:</i> (total 18 credits)				MAT 311 Ceramic Processing I	4	0
MAT 218 Introduction to				MAT 312 Ceramic Processing II	0	3
Ceramic Engineering	0	4		MAT 417 Ceramic Subsystem		
	<u>0</u>	<u>4</u>		Design	0	3
				MAT 493 Ceramic Field Exercises I ..	1	0
				Technical Elective	3	0
					<u>8</u>	<u>6</u>
2. <i>Production:</i> (total 19 credits)				EC 432 Industrial Relations	3	0
IE 332, Motion & Time Study	0	4		IE 343 Plant Layout &		
Technical Elective	3	0		Materials Handling	0	3
	<u>3</u>	<u>4</u>		IE 443 Quality Control	3	0
				Technical Elective	0	3
					<u>6</u>	<u>6</u>
3. <i>Electrical:</i> (total 18 credits)				EE 314 Electronic Circuits	4	0
EE 350 Electrical Power Utilization				EE 336 Industrial Power and		
in Mfg. Processes, will not be				Control Systems	0	3
taken (3)				EE 440 Fundamentals of		
EE 201, 202 Electric				Digital Systems	0	3
Circuits I, II	4	4			<u>4</u>	<u>6</u>
	<u>4</u>	<u>4</u>				

INDUSTRIAL ENGINEERING

Riddick Engineering Laboratories

Professor C. A. ANDERSON, Head of the Department

Professors: J. R. CANADA, R. G. CARSON, JR., S. E. ELMAGHRABY, R. W. LLEWELLYN, R. G. PEARSON; *Associate Professors:* R. E. ALVAREZ, R. H. BERNHARD, J. J. HARDER, A. M. KAMAL, ANCO L. PRAK, S. M. SOLIDAY; *Assistant Professors:* G. E. BENNINGTON, M. J. MAGAZINE, H. L. W. NUTTLE, G. E. TUCKER; *Assistant Professor Emeritus:* R. L. COPE; *Visiting Lecturers:* J. F. BIGGANE, J. W. SIPHRON; *Furniture Manufacturing Extension Specialist:* E. L. CLARK

The industrial engineer designs, improves and installs integrated systems of men, materials and equipment. He draws upon specialized knowledge and skill in the mathematical, physical and social sciences, together with the principles and methods of engineering analysis and design to specify, predict and evaluate the results to be obtained from these systems. The industrial engineer may design work and control systems for many diverse activities, such as a hospital, a department store, an industrial enterprise, an insurance office or government functions. His position in an organization is usually as an adviser to management and as such he is brought into contact with every phase of the organization.

The industrial engineering curriculum has been carefully planned with these functions in mind to prepare the student for both present and future opportunities in the field.

CURRICULUM

The curriculum blends a basic group of technical courses common to all engineering with specialized courses in the two major areas of industrial engineering—the design of man and machine systems and the design of management control systems. The departmental course offerings stress the mathematical and statistical techniques of industrial systems analysis; the quantitative methodologies of operations research; the use of digital and analog computers as a tool for problem solving and simulations; the economic considerations of alternatives; the control of product quality and production; the specifications of the manufacturing process including the equipment and tooling; and the utilization of biobehavioral engineering principles. This curriculum is accredited by the Engineers Council for Professional Development.

GRADUATION REQUIREMENTS

A minimum of six weeks of continuous, gainful employment is required. This employment may be any level but should be related to industrial engineering activities. The student assumes responsibility for obtaining his own employment and making arrangements with his employer to provide evidence thereof to the head of the Department of Industrial Engineering. A letter from the employer stating the extent and dates of employment, a description of work performed and an evaluation of the student's performance is suitable evidence. In general the student should plan to take such employment between his junior and senior years.

STUDENT ACTIVITIES

Student organizations within the department include a chapter of the American Institute of Industrial Engineers. This student function has demonstrated its caliber by ranking high in the Annual Student Award in competition with the AIIE chapters at other institutions. Departmental and student activities of a professional and social character are sponsored by the organization.

An active chapter of Alpha Pi Mu, the industrial engineering honor society, gives recognition to the outstanding students in the junior and senior classes. The membership annually undertakes projects of value to industrial engineering students and the department.

INDUSTRIAL ENGINEERING CURRICULUM

For the freshman year see page 147.

SOPHOMORE YEAR			
<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanities and Social Science*	3	EM 205 Principles of Engr. Mech.	3
MA 202 Anal. Geom. & Calc. III	4	Humanities and Social Science*	3
MAT 201 Str. & Prop. of Engr. Mtl. I	3	IE 311 Engineering Proj. Anal.	3
PY 208 General Physics	4	MA 301 Apld. Diff. Equations I	3
Physical Education	1	ST 371 Intro. to Prob. & Stat.	4
	15	Physical Education	1
			17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CSC 111 Algorithmic Languages I	2	EC 312 Accounting I	3
Engineering Mechanics Elective	3	IE 352 Work Analysis & Design	4
Humanities and Social Science*	3	IE 354 Human Factors Engr.	3
IE 351 Product & Process Engr.	3	IE 401 Industrial Engr. Analy. I	3
IE 353 Stat. Quality Control	3	Free Elective	3
IE 361 Quan. Meth. in Ind. Engr.	3		
	<hr/> 17		<hr/> 16

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EE 331 Principles of Elec. Engr.	3	Engineering Science Elective	3
EE 339 Prin. of Elec. Engr. Lab.	1	Humanities and Social Science	3
Humanities and Social Science	3	IE 421 Data Proc. & Prod. Cont.	
MAE 301 Engr. Thermodynamics I	3	Systems	3
Advised Technical Elective	3	Advised Technical Elective	3
Free Elective	3	Free Elective	3
	<hr/> 16		<hr/> 15

* See pages 145-146 for information about the humanities sequence.

PROFESSIONAL STUDY

A fifth, or professional year of study is offered in industrial engineering by means of specialized and advanced course work. A student may elect a speciality area in consultation with his adviser and then develop a program of study which suits his interests. A student may specialize in production engineering, in decision-making processes as related to industrial engineering or in administrative engineering. Typical programs in each of these areas are presented below. This fifth year of study leads to the professional degree in industrial engineering. Regulations concerning the professional program are shown on pages 173-174.

PRODUCTION ENGINEERING

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EC 409 Introduction to Prod. Cost	3	IE 517 Automatic Processes	3
IE 441 (PSY 441) Human Factors		IE 521 Contr. Sys. & Data Proc.	3
& Equip. Dsn.	3	IE 543 Standard Data	3
IE 511 Adv. Engr. Project Analy.	3	ST 516 Expr. Stat. for Engrs.	3
IE 515 Process Engineering	3	Elective	3
ST 515 Expr. Stat. for Engrs.	3		
	<hr/> 15		<hr/> 15

INDUSTRIAL ENGINEERING

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
IE 505 (MA 505, OR 505)		IE 509 (OR 509) Dynamic Programming ..	3
Mathematical Programming I	3	IE 522 (OR 522) Dyn. of Ind. Sys.	3
IE 511 Adv. Engr. Project Analy.	3	IE Elective	3
IE 521 Contr. Sys. & Data Proc.	3	ST 516 Expr. Stat. for Engrs.	3
ST 421 Introduction to Math. Stat.	3	Elective	3
ST 515 Expr. Stat. for Engrs.	3		
	<hr/> 15		<hr/> 15

ADMINISTRATIVE ENGINEERING

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EC 525 Mgt. Policy & Dec. Making	3	EC 501 Price Theory	3
Economics Elective	3	Economics Elective	3
IE 522 (OR 522) Dyn. of Ind. Sys.	3	IE Elective	3
IE 511 Adv. Engr. Project Analy.	3	IE 521 Contr. Sys. & Data Proc.	3
ST 515 Expr. Stat. for Engrs.	3	ST 516 Expr. Stat. for Engrs.	3
	<hr/> 15		<hr/> 15

FURNITURE MANUFACTURING AND MANAGEMENT

James T. Ryan Associate Professor ANCO L. PRAK, In Charge

In North Carolina, the furniture industry ranks third in terms of its dollar volume of sales and second in terms of its employment. In order to meet the increasing demand for furniture products the industry is rapidly changing towards mechanization and more sophisticated management controls.

The furniture manufacturing and management program is the only one of its kind in the United States. The generous support and cooperation of the industry during plant and market field trips gives students an in-depth understanding of manufacturing. The faculty in the furniture program is keeping abreast of industry problems through frequent contacts and through service on committees of the Southern Furniture Manufacturers Association.

Because of the nature of the industry and the excellent cooperation from the manufacturers, the cooperative education program is particularly well suited to the FMM curriculum.

CURRICULUM

It is the purpose of the curriculum leading to the degree of Bachelor of Science in furniture manufacturing and management to prepare graduates for technical and managerial positions in the industry.

The curriculum stresses the application of engineering and technology to furniture manufacturing. Related subjects such as management, accounting and economic analysis cover the business side of modern furniture production systems.

GRADUATION REQUIREMENTS

In addition to the academic course work a minimum of six weeks of continuous, gainful employment in a furniture manufacturing plant is required. In general the student should plan to take such employment between his junior and senior years.

STUDENT ACTIVITIES

The industrial engineering department sponsors the Furniture Club, which is operated by the students. All students in the curriculum are eligible for membership in the organization. The club brings in speakers from industry and holds social gatherings for the students.

FURNITURE MANUFACTURING AND MANAGEMENT

For the freshman year see page 147.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
E 240 Furniture Graphics	3	CSC 111 Algorithmic Languages I	2
Humanities and Social Science	3	Humanities and Social Science	3
PY 212 General Physics	4	IE 241 Furn. Mfg. Proc. I	3
SP 231 Expository Speaking	3	ST 361 Intro. to St. for Engr. I	3
Physical Education	1	WPS 201 Wood Struc. & Prop.	3
	—	Physical Education	1
	14		15

Summer Practicum WPS 205, 206, 207, 208, 209

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EC 312 Accounting I	3	IE 301 Engineering Economy	3
Humanities and Social Science	3	IE 341 Furn. Plant Layout & Design	3
IE 321 Bus. Data Processing	3	IE 443 Quality Control	3
IE 332 Motion and Time Study	4	Advised Elective	3
IE 340 Furn. Mfg. Proc. II	3	Free Elective	3
	16		15

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanities and Social Science	3	EC 426 Personnel Management	
IE 420 Manufacturing Controls	3	or	
IE 440 Furn. Management Analy.	3	EC 432 Industrial Relations	3
Advised Elective	4	Humanities and Social Science	3
	13	Advised Elective	3
		Free Elective	6
			15

* See pages 145-146 for information about the humanities sequence.

GRADUATE STUDY

The department offers advanced degrees in industrial engineering including the Master of Science, the Master of Industrial Engineering and the Doctor of Philosophy degrees.

For further information concerning graduate study in industrial engineering, please consult the current Graduate School Catalog.

MATERIALS ENGINEERING

Page Hall

Professor W. W. AUSTIN, JR., Head of the Department

Professors: J. R. BEELER, JR., A. A. FAHMY, W. W. KRIEGEL, K. L. MOAZED, H. PALMOUR, III, H. H. STADELMAIER; Research Professor: R. F. STOOPS; Adjunct Professors: H. M. DAVIS, J. K. MAGOR; Associate Professors: R. B. BENSON, JR., J. V. HAMME, G. O. HARRELL, C. R. MANNING, JR.; Adjunct Associate Professor: G. MAYER; Assistant Professor: J. C. HURT; Instructor: J. M. WALLER

The primary objectives of the Department of Materials Engineering are the education and professional development of qualified technical and administrative leaders for industries and government agencies involved with the design, development, selection and processing of engineering materials. Typical of the industries served by materials engineers are: aerospace, electrical and electronics, construction, nuclear power and transportation.

CURRICULA

Undergraduate curricula in the department are comprised of a common three-year program of fundamental courses followed by a fourth year in which the student may choose to specialize in ceramic engineering or in materials engineering. Fifth year professional programs are available for advanced work and further specialization in both of these fields.

The graduate program is designed to permit students from a variety of materials-related undergraduate disciplines to engage in advanced study and research leading to the M.S. or Ph.D. degrees. Graduate degree research and specialization may be in ceramics, metallurgy or in a broad-based combination

of materials-oriented disciplines including materials physics, materials processing or polymeric materials.

FACILITIES

The facilities of the Department of Materials Engineering are housed in Page Hall, and in the Engineering Research complex. They include departmental offices, classrooms and extensive laboratory facilities for instructional work and research in the areas of study covered by the department. Typical of the numerous well-equipped laboratories are those for instruction in the following subject areas: X-ray diffraction, differential thermal analysis, thermogravimetric analysis, electron microprobe analysis, radiography, metallography, electron microscopy, mechanical behavior of materials and nuclear fuel research.

STUDENT ACTIVITIES

The student branches of the American Ceramic Society, and the American Society for Metals, through monthly meetings provide an effective medium for the professional growth of the students. Programs include presentation of student papers, guest speakers and social contact between students and staff. Participation in student technical societies acquaints the student with parliamentary and organization procedures which are of great importance to professional, industrial and civic life. Students are encouraged to attend local, section and national meetings of their respective societies. Keramos, the oldest professional engineering fraternity, and Alpha Sigma Mu, honorary metallurgical fraternity, have active chapters in the department. These fraternities are dedicated to the promotion of scholarship, mental achievement and general service to their professional disciplines.

MATERIALS ENGINEERING AND CERAMIC ENGINEERING CURRICULA

For the freshman year see page 147.

SOPHOMORE YEAR		JUNIOR YEAR	
	Credits		Credits
EE 331 Prin. of Electrical Engineering	0 3	CH 331 Introductory Physical Chemistry	4 0
EE 339 Principles of Electrical Engineering Laboratory	0 1	Humanities and Social Sciences	3 3
EM 205 Principles of Engineering Mechanics	0 3	MAT 301 Equilibrium and Rate Processes in Materials Science	0 3
Humanities and Social Sciences*	3 3	MAT 310 Physical Examination of Materials	0 3
MA 202 Analytic Geometry & Calculus III	4 0	MAT 450 Mechanical Properties of Materials	3 0
MA 301 Applied Differential Equations	0 3	MAT 411, 412 Physical Principles in Materials Science I, II	3 3
MAT 201 Structure & Properties of Engineering Materials I	3 0	Elective	3 3
PY 208 General Physics	4 0		16 15
Elective	0 3		
Physical Education	1 1		
	15 17		
Six weeks industrial employment			
SENIOR YEAR			
CERAMIC ENGINEERING			
	Credits		
Humanities and Social Sciences	3 3	MAT 437 Introduction to the Vitreous State	3 0
MAT 311, 312 Ceramic Processing I, II	4 3	MAT 493, 494 Ceramic Field Exercises I, II	1 1
MAT 417 Ceramic Subsystem Design	0 3	Elective	0 3
MAT 435, 436 Physical Ceramics I, II	4 3		15 16
		Total Credits—127	

SENIOR YEAR MATERIALS ENGINEERING

	<i>Credits</i>		
CHE 543 Technology of Plastics	0 3	MAT 435, 436 Physical Ceramics	
Humanities and Social Sciences	3 3	I, II	4 3
MAT 423, 424 Materials Factors		Elective	3 0
in Design I, II	3 4		16 16
MAT 431, 432 Physical Metallurgy			Total Credits—128
I, II	3 3		

* Humanities and Social Science courses will be taken according to the standard pattern for the School of Engineering.

OPPORTUNITIES

Opportunities open to graduates in materials engineering and ceramic engineering are virtually unlimited. A graduate materials engineer may choose from a wide selection of companies, locations and types of work. Among the more important job opportunities open to materials engineers are those in research and development of new materials urgently needed in the rapidly expanding fields of chemical, mechanical, aerospace, electronic and nuclear technology. With the rapid industrialization of the South and particularly the State of North Carolina, new opportunities are constantly developing for materials engineers who will play a vital role in maintaining the forward progress of the state and region.

Professional training in ceramic engineering provides opportunities for employment in industries producing a wide variety of essential products including glass in all its forms, enamels and protective coatings for metals, structural clay products such as brick and tile, refractories for furnace linings, thermal insulators, electrical insulators, dielectric components, Portland cement, gypsum products, abrasives, pottery products and hundreds of other items. In addition to these "end products" ceramics are finding ever increasing applications as components in the electronic, aerospace, automotive and atomic energy fields. Initial employment upon graduation may be in the fields of research and development, in-plant operation and control, and in technical sales and service. Such employment may lead to positions as directors, superintendents, production managers and finally, administrative officers.

PROFESSIONAL STUDY

A fifth or professional year of study is offered in materials engineering and in ceramic engineering as a continuation of the undergraduate programs. This professional year of study offers specialized advanced course work leading to the professional degrees of Materials Engineer or Ceramic Engineer. It is especially designed for students planning careers in industrial production activities, or in technical service and sales. Each program of study is designed to suit the needs of the individual student. The curriculum shown below is typical of these programs.

Regulations covering professional study are shown on pages 173-174.

TYPICAL PROFESSIONAL PROGRAM IN MATERIALS ENGINEERING

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MAE 402 Heat and Mass Transfer	3	CHE 540 Electrochemical Engineering	3
MAT 495 Experimental Engineering I	3	MAE 515 Experimental Stress Analysis	3
MAT 506 Electron Microscopy	3	MAT 496 Experimental Engineering II	3
MAT 521 Advanced Physical Metallurgy I	3	MAT 522 Advanced Physical	
PY 407 Introduction to Modern Physics	3	Metallurgy II	3
	15	MAT 529 Properties of High	
		Temperature Materials	3
			15

MECHANICAL AND AEROSPACE ENGINEERING

Broughton Hall

Professor R. W. TRUITT, Head of the Department

Professor C. F. ZOROWSKI, Associate Head of the Department

Professors: N. W. CONNER, B. H. GARCIA, JR., F. J. HALE, F. D. HART, H. A. HASSAN, R. B. KNIGHT, M. N. OZISIK, J. N. PERKINS, F. O. SMETANA, J. E. SUNDERLAND, J. C. WILLIAMS, III, J. WOODBURN; Professor and Graduate Administrator: J. S. DOOLITTLE; Visiting Professor: W. C. GRIFFITH; Adjunct Professors: R. M. CHAMBERS, R. W. GRAHAM; Professors Emeriti: H. B. BRIGGS, R. M. PINKERTON; Associate Professors: W. E. ADAMS, J. A. BAILEY, R. F. BARRETT, F. R. DEJARNETTE, H. A. MACKIE, C. J. MOORE, JR., L. H. ROYSTER, J. K. WHITFIELD; Visiting Associate Professor: E. M. AFIFY; Adjunct Associate Professors: S. KUMAR, J. J. MURRAY, E. C. YATES, JR.; Associate Professor Emeritus: W. S. BRIDGES; Assistant Professors: D. W. COTT, J. A. DAGGERHART, JR., T. B. LEDBETTER, J. C. MULIGAN, L. J. PAVAGADHI; Adjunct Assistant Professor: G. L. SMITH; Assistant Professor Emeritus: T. J. MARTIN, JR.; Instructor: G. O. BATTON; Instructors Emeriti: M. LEWIS, T. L. NASH; Extension Specialist: A. S. BOYERS

Engineers are motivated by a desire to satisfy human needs through the application of scientific principles in such a manner as to place the fruits of their work within the economic reach of vast segments of humanity. To identify and evaluate human needs, modern engineers must have a sound education in the basic sciences, mathematics and the humanities. The gap between the discoveries of basic science and their application in the satisfaction of human needs is provided by an area of science known as the engineering sciences. It is with education in the engineering sciences and the development of talent in applying the principles of engineering sciences that departments of engineering are principally concerned.

Mechanical engineering covers a broad spectrum of engineering responsibility in such areas as nuclear and conventional power generation, missiles, rockets, jet engines, propulsion systems for land, sea and air vehicles, refrigeration, air conditioning, combustion of fuels, instrumentation of industrial processes, solar energy and the design of a wide variety of technical systems. Aerospace engineering shares responsibility with mechanical engineering for many of the areas described above but is principally concerned with the analysis and design of modern aircraft and space vehicles and with the phenomena of air and space flight.

Because of the close relationship between mechanical and aerospace engineering, both curricula are administered by the Department of Mechanical and Aerospace Engineering at North Carolina State University. There is close cooperation between the facilities of the two disciplines in which responsibility for such engineering sciences as thermodynamics, heat and mass transfer, gas dynamics, aeroelasticity, vibrations, fluid mechanics, magnetohydrodynamics, plasmagas dynamics, aerodynamics, propulsion and instrumentation theory are shared.

CURRICULA

The curricula in mechanical and aerospace engineering are based on a firm foundation in mathematics, physics, chemistry, humanities and social sciences. The student's knowledge in the basic engineering sciences germane to mechanical and aerospace engineering is carefully developed in the courses offered in this

department and other departments of the School of Engineering. Finally, the curricula provide an active experience in which the student's creative talents and imagination are challenged in several areas of application. This experience is gained through a choice of courses and project work in the senior year.

The four-year undergraduate curricula in both mechanical and aerospace engineering prepare graduates who are equipped to profit from their experience in the practice of engineering and to become early contributors in the solution of engineering problems of scientific and economic complexity. Both curricula offer a firm basis for further advanced study in graduate schools.

MECHANICAL ENGINEERING CURRICULUM

For the freshman year see page 147.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EM 205 Princ. of Engineering Mechanics ..	3	CSC 111 Algor. Languages I	2
Humanities, Social Sciences*		EM 305 Engineering Dynamics	3
or		Humanities, Social Sciences*	
Free Elective	3	or	
MA 202 Anal. Geometry and Cal. III	4	Free Elective	3
PY 208 General Physics	4	MA 301 Appl. Diff. Equations I	3
Physical Education	1	MAE 216 Elements of Mech. Engr.	3
	<u>15</u>	Physical Education	1
			<u>15</u>

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EE 331 Princ. of Elec. Engr.	3	EE 332 Princ. of Elec. Engr.	3
Humanities, Social Sciences*		EM 303 Fluid Mechanics I	3
or		Humanities, Social Sciences*	
Free Elective	3	or	
MAE 301 Engr. Thermodynamics I	3	Free Electives	6
MAE 305 Mech. Engr. Lab. I	1	MAE 302 Eng. Thermodynamics II	3
MAE 315 Dynamics of Machines	3	MAE 306 Mech. Engr. Lab. II	1
MAT 201 Struc. and Prop. of Engr.	3	MAE 316 Strength of Mech. Comp.	3
Materials I	3		<u>16</u>
	<u>16</u>		

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Departmental Elective	3	Departmental Elective	3
Humanities, Social Sciences*		Humanities, Social Sciences*	
or		or	
Free Electives	6	Free Elective	3
MAE 401 Energy Conversion	3	MAE 402 Heat and Mass Transfer	3
MAE 415 Mech. Engr. Analysis	3	MAE 416 Mech. Engr. Design	4
MAE 405 Mech. Engr. Lab III	1		<u>16</u>
	<u>16</u>		

Total Hours—126

Students may elect to take PY 205, 206 and 207 in place of PY 205, 208. Re-arrangement of the schedule of courses to accomplish this will be worked out in consultation with the student's adviser.

* See pages 145-146 for information concerning the humanities, social science sequence.

AEROSPACE ENGINEERING CURRICULUM

For the freshman year see page 147.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EM 205 Princ. of Engr. Mechanics	3	CSC 111 Algor. Languages I	2
Humanities, Social Sciences*		EM 305 Engineering Dynamics	3
or		Humanities, Social Sciences*	
Free Elective	3	or	
MA 202 Analytic Geometry and		Free Elective	3
Calculus III	4	MA 301 Appl. Diff. Equations I	3
PY 208 General Physics	4	MAE 250 Intro. to Aerospace Engr.	3
Physical Education	1	Physical Education	1
	<hr/> 15		<hr/> 15

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EE 201 Electric Circuits I	4	EE 332 Princ. of Elec. Engr.	3
or		EE 333 Princ. of Elec. Engr. Lab.	1
EE 331 Princ. of Elec. Engr.	3	Humanities, Social Sciences*	
and		or	
EE 339 Princ. of Elec. Engr. Lab.	1	Free Elective	3
MAE 301 Engr. Thermodynamics I	3	MAE 356 Aerodynamics II	4
MAE 355 Aerodynamics I	4	MAE 365 Air-Breathing Propulsion	
MAE 361 Aerospace Vehicle		Systems	4
Performance	3	MAE 371 Aerospace Vehicle Struc. I	3
MAT 201 Struc. & Properties of			<hr/> 18
Engr. Materials I	3		
	<hr/> 17		

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanities, Social Sciences*		Departmental Elective	3
or		Humanities, Social Sciences*	
Free Electives	6	or	
MAE 462 Flight Vehicle Stability		Free Electives	9
and Control	3	MAE 479 Aerospace Vehicle Design	4
MAE 467 Rocket Propulsion	3		<hr/> 16
MAE 472 Aerospace Vehicle Struc. II	4		
	<hr/> 16		

Total Hours—129

* See pages 145-146 for information concerning the humanities, social science sequence.

PROFESSIONAL STUDY

A fifth or professional year of study is offered in mechanical engineering for graduates who desire to return to the University for a program of concentrated study in a selected area. This program is intended primarily for practitioners and is, in no sense, a graduate program leading to the usual advanced degrees. The degree of Mechanical Engineer is conferred upon graduates of the fifth-year program.

GRADUATE STUDY

The Department of Mechanical and Aerospace Engineering offers the Master of Mechanical Engineering degree, the Master of Science degree and the Doctor of Philosophy degree. Prospective applicants should consult the Graduate School Catalog.

NUCLEAR ENGINEERING

Burlington Nuclear Laboratories

Professor R. L. MURRAY, Head of the Department

Professors: J. R. BEELER, T. S. ELLEMAN, R. P. GARDNER, R. F. SAXE, L. R. ZUMWALT; Associate Professors: J. R. BOHANNON, JR., A. CARNESALE, W. E. KIKER, C. E. SIEWERT, K. VERGHESE; Visiting Assistant Professor: E. STAM; Nuclear Engineering Extension Specialist: J. KOHL; Reactor and Applications Engineer: J. P. F. LAMBERT; Reactor Health Physicist: D. W. MORGAN, JR.; Nuclear Instrumentation Engineer: J. T. BEARD

The field of nuclear engineering is concerned with the engineering aspects of the control, release and utilization of nuclear energy. Nuclear reactors serve many functions—they serve as heat sources for economical electric power plants, are the basis of modern propulsion systems for ships and submarines, and produce fissionable and radioactive isotopes for a variety of peaceful applications. Nuclear devices supply auxiliary power and propulsion energy for space vehicles in operation and under development. The purpose of the nuclear engineering program is to educate the individual in those scientific and engineering principles essential for effective and productive contributions in industrial, university and government service.

CURRICULUM

Nuclear engineers have the opportunity to work in the areas of nuclear systems research, design, development, testing, operation and marketing. The Bachelor of Science degree program is designed to prepare graduates for positions in industry or government laboratories or for graduate study in the field. The curriculum incorporates basic sciences and engineering, with special emphasis on mathematics and physics, followed by coursework in nuclear science and technology. Attention is given to the engineering design of nuclear reactors, radiation facilities and associated systems.

FACILITIES

Facilities available on campus for nuclear education at the undergraduate level as well as at the graduate level include: heterogeneous enriched uranium reactor, 10 kilowatt, with beam ports, a fast sample transport system, thermal column, and irradiation volume; Cobalt-60 gamma source, 50,000 curies; multi-channel analyzers for gamma ray analysis; solid state detectors; Van-de Graaff positive ion accelerator with pulsed source; natural uranium, water-moderated subcritical assembly; digital computer, IBM System/360, Model 75; analog computer; pulsed neutron source; radiation detection and control laboratory; activation analysis laboratory; high- and low-level radiochemistry laboratories; a 1-MW, pulsing "PULSTAR" research reactor is currently under construction with operation scheduled for early 1971.

This new heterogeneous enriched uranium reactor provides high steady state fluxes and 2200 MW pulses. The reactor facility includes thermal column, bulk irradiation facility, sample irradiation tubes, pneumatic tubes and a neutron diffractometer. The reactor is used for student laboratory courses, research and services.

OPPORTUNITIES

Although the nuclear industry is relatively young, it already represents a major national effort. Reactor development and construction have proceeded at a

remarkable pace and will continue to grow as we become increasingly reliant upon nuclear energy as a substitute for energy from fossil fuels. Industrial applications of radiation will accelerate as the economic potential of such methods becomes even more firmly established. There continues to be a substantial need for nuclear engineers, and prospects for the future are promising.

NUCLEAR ENGINEERING CURRICULUM

For the freshman year see page 147.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CSC 111 Algorithmic Languages I	2	EM 200 Introduction to Mechanics	3
Humanities and Social Sciences*	3	Humanities and Social Sciences*	3
MA 202 Analytic Geometry and Calculus III	4	MA 301 Applied Differential Equations I ..	3
MAT 201 Structures and Properties of Engineering Materials I	3	NE 201 Applications of Nuclear Energy ..	3
PY 206 General Physics	4	PY 207 General Physics	4
Physical Education	1	Physical Education	1
	<hr/> 17		<hr/> 17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EE 331 Principles of Electrical Engineering	3	EE 332 Principles of Electrical Engineering	3
EM 303 Fluid Mechanics I	3	Humanities and Social Sciences*	3
MAE 301 Engineering Thermodynamics I ..	3	MA 401 Applied Differential Equations II ..	3
NE 301 Fundamentals of Nuclear Energy ..	4	MAE 303 Engineering Thermodynamics III	3
Free Elective	3	NE 302 Fundamentals of Nuclear Engineering	4
	<hr/> 16		<hr/> 16

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanities and Social Sciences*	3	Advised Nuclear Engineering Electives	6
NE 401 Reactor Analysis and Design	4	Humanities and Social Sciences*	3
NE 402 Reactor Engineering	4	NE 403 Nuclear Engineering Design Projects	2
Advised Technical Elective	3	Free Elective	3
Free Elective	3		<hr/> 14
	<hr/> 17		

* Humanities and Social Sciences sequence to be taken according to standard pattern for School of Engineering.

PROFESSIONAL STUDY

A fifth-year professional curriculum leading to the degree Nuclear Engineer is offered. This program emphasizes course work rather than research, and is designed to suit the needs and objectives of the individual student. A suitable course of study may be arranged for a student holding a bachelor's degree in any branch of engineering.

Information on professional study is also given on pages 173-174.

GRADUATE STUDY

The Department of Nuclear Engineering offers the Master of Science and Doctor of Philosophy degrees. Prospective applicants should consult the Graduate School Catalog.

PROFESSIONAL PROGRAM IN ENGINEERING

The School of Engineering offers professional curricula leading to the degrees Ceramic Engineer, Civil Engineer, Chemical Engineer, Electrical Engineer, Industrial Engineer, Mechanical Engineer, Materials Engineer and Nuclear Engineer. A program of studies is tailor-made to fit the particular needs of each student to help him prepare for a professional career in engineering.

It is the intent of the program to emphasize professional course work rather than research. The curriculum consists of a minimum of 30 credits of course work making up a planned program designed to fit the student's objective. Samples of typical programs may be found under the appropriate departmental curricula.

ADMISSION

Applicants who hold the bachelor's degree in engineering from recognized colleges will be admitted to the professional program of the School of Engineering upon presentation of official credentials. For unconditional admission, these credentials must show the completion, with a minimum grade-point average of 2.5 (C+), of an amount of undergraduate work in the proposed field of professional study corresponding to that normally required for a bachelor's degree in that field.

Admission on a provisional basis may be granted applicants who do not meet the formal requirements. In case of insufficient preparation, prerequisite courses will be prescribed in addition to the normal program requirements.

Application should be filed in the office of the dean of the School of Engineering at least 30 days in advance of the semester in which admission is sought.

GENERAL REGULATIONS

The following regulations of the School of Engineering will be observed:

1. An undergraduate enrolled at North Carolina State University, who plans to undertake a professional program and who has fulfilled all requirements for the bachelor's degree except for a few courses, may be permitted to enroll in courses for credit toward the professional degree provided the student has given notice of his purpose to the dean of the School of Engineering.

2. A limited amount of credit to be applied toward the requirements for the professional degree may be transferred to North Carolina State University from recognized institutions of university grade offering advanced work in engineering and related fields. Such a transfer of credit must be recommended by the head of the department in which the student does his major work and approved by the dean of the School of Engineering.

3. Professional students are classified as post-baccalaureate students and are subject to rules and regulations as established and administered by the dean of the School of Engineering.

4. Grades for such completed course are reported to the dean of the School of Engineering and to the Office of Registration. A minimum grade of "C" must be made in each course to obtain credit. A quality point average of 2.5 (C+) in all course work must be attained to satisfy requirements for a professional degree.

5. Work completed more than six years prior to the date on which the professional degree is to be granted may not be used as credit toward the professional degree, unless approved by the head of the department concerned and the dean of the School of Engineering.

6. Each professional student will be assigned an adviser in the area of the

work in which he is majoring. The function of the adviser is to assist the student in preparing a program of study and to counsel him in his academic work. The student will be required, with the assistance of his adviser, to prepare a complete plan of study before the end of his first semester in residence. This program of study is subject to the approval of the dean of the School of Engineering.

ENGINEERING RESEARCH

Riddick Laboratories Building

Research Professor R. F. STOOPS, Acting Head

Research Professors: H. PALMOUR, III, H. H. STADELMAIER; Research Associate Professor: FRANCES M. RICHARDSON; Assistant Professor: J. C. HURT; Research Associates: K. R. BROSE, A. E. LUCIER; Research Assistant Technologist: B. M. GAY; Research Assistants: MARIA L. FIEDLER, L. T. JORDAN, G. S. SHEFFIELD

Engineering Research was originally established in 1923 as the Engineering Experiment Station and was funded through a special appropriation of the General Assembly. The program was established to serve the following purposes: (1) to support fundamental research in the field of applied sciences, (2) to develop new or improved processes that will provide wider utilization of the natural resources of the State, and (3) to offer to industry, both large and small, research services devoted to the solution of technical problems and the development of new products. To accomplish these objectives Engineering Research operates a metallurgical and a ceramic engineering research group, a pyrochemical research group and specialized service laboratories. These provide special services such as electron microscopy, electron microprobe analysis, x-ray diffraction and fluorescent analyses, precision machine shop work, electronic equipment repairs, mechanical testing, etc. The department's research activities, particularly those involving metals and ceramics, have received national and international recognition. The applied research of the department has provided much needed assistance to existing industries in the state and has resulted in the establishment of new industries in North Carolina.

Engineering Research also provides administrative and general services to support the research programs in the academic departments of the School of Engineering. The department operates an administrative and services unit which administers all of the School of Engineering's research contracts and grants. These had a value of \$2,014,000 during the 1968-69 fiscal year, and the total expenditures for all research activities in the School of Engineering was \$3,461,000 during the period. This research resulted in 270 scientific and technical publications.

INDUSTRIAL EXTENSION SERVICE

Riddick Building and Daniels Hall

J. R. CANADA, Assistant Dean of Engineering for Extension

Director of Field Services: J. R. HART; Field Representative in Charge: M. R. SPARKS; Engineering Extension Coordinator: C. S. COOPER; Media Training Coordinator: J. E. KIMBRELL; Marine Sciences Project Director: N. B. ANGEL; Departmental Extension Specialists: R. F. DEBRUHL, D. R. JOHNSTON (Civil Engineering); H. M. ECKERLIN (Engineering Mechanics); E. L. CLARK (Industrial Engineering); A. S. BOYERS (Mechanical and Aero-

space Engineering); J. KOHL (Nuclear Engineering); *Field Representatives*: W. W. ERWIN, D. E. HARRELL, T. W. STEPHENSON, J. B. TRAVIS; *Industrial Specialists*: S. D. COWARD, F. L. EARGLE; *Extension Training Specialist*: R. G. SMITH; *Mechanical Engineer*: H. L. MUDGE; *Furniture Extension Specialist*: E. L. BRIGGS, JR.; *Director of Greensboro Graduate Engineering Program*: J. W. JOSEPH; *Consultant*: L. E. GATES

The Industrial Extension Service is the organization designated by the University's School of Engineering to provide educational, informational, referral and technical assistance services to the industrial community in the state. It provides extension education and field services in direct response to expressed industrial needs.

EXTENSION EDUCATION

The objective of this program is to serve the needs of North Carolina's industry for continuing education through the offering of short courses and conferences, supervisory development workshops, evening certificate courses and correspondence and evening courses for credit, and ETV courses. Also, technical bulletins, directories and packaged in-plant training course materials are prepared and distributed.

FIELD SERVICES

The objectives of the Field Services Program are to determine the needs and interests of North Carolina's industry and to provide appropriate liaison, referral, informational and technical assistance services. This includes training and technical assistance to small industry, the maintenance and operation of a film lending library, and the maintenance and operation of a leading library of programmed instruction material.

MINERALS RESEACH LABORATORY

180 Coxe Avenue

Asheville, North Carolina

W. T. MCDANIEL, JR., *Chief Engineer*

Ore Dressing Engineer: I. H. REDEKER; *Mineral Dressing Engineers*: E. H. BENTZEN, III, R. D. KAUFFMAN, R. M. LEWIS; *Ore Dressing Specialist*: J. P. NEAL; *Chemical Engineer*: P. N. SALES

The Minerals Research Laboratory is operated by the School of Engineering. The primary objectives of the laboratory are: (1) to supply technical assistance to mineral producers of North Carolina through research and development, (2) to aid in establishing new industries in the State, and (3) to develop, conserve and enhance the value of the mineral resources of North Carolina. Since it was established by the General Assembly in 1946, the laboratory has made important contributions toward the above objectives. An estimated \$100,000,000 has been invested in plants in the State using processes developed at the laboratory.

The principal efforts of the laboratory are in the area of mineral recovery, and in recent years emphasis has been on recovery of valuable minerals from wastes. For example, successful waste utilization programs for the mica and feldspar industries have improved the competitive position of these companies, have reduced pollution, and have resulted in conservation of the State's mineral

resources. Improved beneficiation methods are being developed for mica, feldspar, phosphate, olivine, chromite, kyanite, limestone, clay, pyrophyllite, talc and ilmenite.

The facilities of the laboratory include the latest equipment for separation and improving the quality of minerals. Materials may be processed in the laboratory in small batches or on a full pilot-plant scale.

FOREST RESOURCES

Biltmore Hall

ERIC L. ELLWOOD, *Dean*

L. C. SAYLOR, *Assistant Dean*

The products and services dependent upon the forests of the South offer many opportunities for challenging and rewarding careers to young people. Our forests provide timber and water, a habitat for wildlife and an environment for outdoor recreation, each a vital factor in the economy and well-being of North Carolina. Students graduating from one of the school's programs are qualified for professional positions managing forest lands, or harvesting and manufacturing the products or providing the services developed from these lands.

North Carolina is one of the nation's most important forest states. Its 20 million acres of commercial forest land form the base for manufactured products valued at nearly two billion dollars each year, support a \$400 million tourist industry, and provide employment for nearly 20 percent of the industrial labor force.

The forests of the South support the region's largest industry. New wood-using industries are moving into the South on an unprecedented scale, and existing industries employ more than 650,000 persons and have an annual output in excess of six billion dollars. Outdoor recreation in the United States is a multi-billion dollar industry and is expanding at an explosive rate as a result of our growing population, affluence, mobility and leisure time. The forest-based industries, together with government agencies, demand a large number of well-educated, technically competent men with a wide variety of specialized training, and interdisciplinary background.

Many of the programs of the School of Forest Resources are not duplicated in other southern universities and for this reason the Trustees of the University of North Carolina and the Southern Regional Education Board have designated the school's programs as regional in nature, imposing no limit to enrollment of qualified out-of-state students.

CURRICULA

The school, through its departments of forestry, recreation resources administration, and wood and paper science provides programs which offer a broad education in the biological and physical sciences, and the opportunity to develop a sound cultural background. Students work toward careers in the fields of conservation, forestry, natural resources recreation management, pulp and paper science and technology, recreation and park administration, and wood science and technology.

A freshman enrolling in the school has a nearly common core of courses during his first semester, enabling him to defer final selection of a curriculum for two or three semesters without undue penalty. An introductory course during this first semester describes all the curricula within the school and the career opportunities each provides.

DEGREES

The Bachelor of Science degree is conferred upon the satisfactory completion of any of the curricula listed above.

The Master of Science, Master of Forestry, Master of Recreation Resources,

Master of Wood and Paper Science and the Doctor of Philosophy degrees are offered. Prospective applicants should consult the Graduate School Catalog.

FACILITIES AND LABORATORIES

The School of Forest Resources is now housed in three modernly equipped buildings on the west side of the campus. A new \$1,700,000 facility, Biltmore Hall, provides classrooms, laboratories and a library. Two specialized buildings house programs unique in the Southeast.

Hodges Wood Products Laboratory—One of the largest and most completely equipped laboratories for the conduct of training and research in wood technology, this structure houses machining, gluing, finishing, preserving, testing and research laboratories, as well as a sawmill, dry kiln and veneer lathe.

Robertson Laboratory of Pulp and Paper—Unique to the South, this building contains wood preparation, chemistry, pulping, testing and coloring laboratories as well as digesters and a small paper machine.

School Forests—The School of Forest Resources with five research and demonstration forests containing more than 80,000 acres has excellent facilities for field instruction. The Hofmann forest on the coastal plain and the Hill, Schenck, Hope Valley and Goodwin forests in the Piedmont provide a wide variety of forest types. The permanent Slocum summer camp for sophomores in forestry is located on the Hill Forest in Durham County.

FIELD INSTRUCTION AND EXPERIENCE

All students are required to present an equivalent of one summer of acceptable work experience in order to meet the graduation requirements. Students are required to consult with their advisers as to what type of employment will be acceptable.

The sophomore summer camp is a requirement for students in forestry. This camp follows the sophomore year for resident students. Transfer students will attend the camp after completing the junior year at N. C. State.

Recreation students are required to participate in an internship program following their junior year.

Wood science and technology students are required to attend a summer practicum following the sophomore year (junior year for transfer students).

Additional field instruction and scheduled trips to representative industries and agencies are required of all students as a part of their class assignments. All students enrolled in the School of Forest Resources pay a laboratory fee of \$5 each semester to cover the costs of off-campus training and supplies. A maintenance and supply fee of \$20 is charged at the time of attending the summer camp, the practicum or the internship.

EXTENSION

The Forestry Extension Program of the Agricultural Extension Service is a vital part of the school's forestry activities. This program serves the land-owners and wood industries of the State, being responsible for securing acceptance, and speeding up application of new ideas and techniques developed through research and experience. The major fields of program emphasis include forest management and wildlife, where extension specialists train and work through the county agents, and wood products, where the specialists work more or less directly with wood industry owners and managers.

In cooperation with the General Extension Division, short courses are offered in a number of fields to provide men in industry and government an opportunity to keep abreast of modern developments in techniques and equipment.

HONORS PROGRAM

Students making exceptional academic records during their freshman and sophomore years may, with the approval of the faculty, elect to follow an honors program. These students must satisfy the core course requirement in any specific curriculum, but are otherwise free to use elective hours for developing individual courses of study designed to meet their needs and to attain their educational goals, subject only to the approval of the honors adviser.

CONSERVATION

(Also see agriculture and life sciences.)

M. G. COOK, *Adviser, School of Agriculture and Life Sciences*

L. C. SAYLOR, *Adviser, School of Forest Resources*

Faculty members in the Departments of Botany, Entomology, Forestry, Plant Pathology, Recreation Resources Administration, Soil Science and Zoology are directly involved in various aspects of education in conservation.

Conservation involves the wise use of natural resources for the benefit of man, without waste. In this day of rapid industrialization, urbanization and population increase, there is a growing and pressing need for people who can make sound judgments in planning and directing management and use of renewable natural resources. Such individuals, conservationists, must be able to view problems from several aspects rather than being narrow in vision. Conservation has been rightly called a philosophy rather than a discipline. However, for the conservationist to apply this philosophy to problem-solving in a modern society, he must be well-trained in the basic concepts of several disciplines.

CURRICULUM

The program in conservation is offered jointly by the School of Agriculture and Life Sciences and the School of Forest Resources. Students will enroll initially in either of the schools depending on the area of conservation to be emphasized. All programs have a certain number of core subjects in common; the specialties are developed through the use of elective courses. For most students, the degree in conservation will be the only degree sought. By the proper choice of electives, however, it will be possible for students wishing stronger backgrounds in certain areas to obtain a dual degree by meeting the basic degree requirements in fields such as botany, forestry, liberal arts, recreation, soil science, wildlife management and zoology, as well as in conservation.

CONSERVATION CURRICULUM

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ALS 103 Orientation		CH 101 General Chemistry I	4
or		ENG 112 Composition & Reading	3
FOR 101 (WPS 101) Introd. to		Humanity and Social Science Elective	3
Forest Res.	1	Apprv. Math Elective	3
BO 200 Plant Life	4	Physical Education	1
or			14
BS 100 Gen. Biology			
ENG 111 Composition & Rhetoric	3		
Hum. & Soc. Sci. Elec.	3		
MA 111 Algebra & Trig.	4		
Physical Education	1		
	16		

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 103 Gen. Chemistry II	4	BO 200 Plant Life	
GY 120 Physical Geology	3	or	
Hum. & Soc. Sci. Elec.	3	ZO 201 Animal Life	4
ZO 221 Conserv. of Nat. Res.	3	English Elective	3
Free Elective	3	Hum. & Soc. Sci. Elec.	3
Physical Education	1	SSC 200 Soils	4
	17	Physical Education	1
			15

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 360 (ZO 360) Ecology	4	Biol. Sci. Elec.	3
Conservation Elective	4	Conservation Elec.	3
FOR 472 Renewable Resource Mgt.	3	Hum. & Soc. Sci. Elec.	3
Hum. & Soc. Sci. Elec.	3	PY 221 College Physics	5
ST 311 Introd. to Statistics	3	RRA 341 Recreation Resource	
	17	Relationships	3
			17

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Biological Sci. Elec.	3	Biol. Sci. Elec.	3
Conservation Elec.	3	Conservation Elec.	3
English Elective	3	Hum. & Soc. Sci. Elec.	3
ZO 353 Wildlife Management	3	Free Electives	6
Free Electives	5		15
	17		

Total Hours—128

FORESTRY

Biltmore Hall

Professor C. B. DAVEY, Head of the Department

TEACHING AND RESEARCH

Professors: F. S. BARKALOW, JR., R. C. BRYANT, A. W. COOPER, E. B. COWLING, J. W. DUFFIELD, J. W. HARDIN, C. S. HODGES, JR. (USDA), J. O. LAMMI, T. E. MAKI, T. O. PERRY, R. J. PRESTON, L. C. SAYLOR, B. J. ZOBEL; *Adjunct Professors:* G. H. HEPTING, N. E. JOHNSON, L. J. METZ, T. H. RIPLEY; *Professor Emeritus:* W. D. MILLER; *Associate Professors:* M. H. FARRIER, W. L. HAFLEY, G. NAMKOONG (USFS); *Adjunct Associate Professors:* E. W. CLARK, J. W. KOENIGS, E. G. KUHLMAN, C. G. WELLS; *Assistant Professors:* L. F. GRAND, D. H. J. STEENSEN, B. F. SWINDEL (USFS), L. W. TOMBAUGH (USFS); *Adjunct Assistant Professor:* H. T. SCHREUDER; *Instructors:* A. G. MULLIN, J. H. ROBERDS; *Liaison Geneticist:* R. C. KELLISON; *Teaching Technician:* T. V. GEMMER; *Research Associates:* L. W. HAINES, L. G. JERVIS; *Research Assistants:* J. B. JETT, JR., W. D. PEPPER (USFS), J. R. SPRAGUE

EXTENSION

Professor W. M. KELLER, In Charge of Forestry Extension

Professor: J. C. JONES; *Associate Professors:* W. T. HUXSTER, JR., F. E. WHITFIELD; *Assistant Professors:* R. S. DOUGLASS, E. M. JONES, W. M. STANTON

The forestry curriculum lays the foundation for a general education and provides training in management of forest land resources. This curriculum

requires knowledge of basic surveying and use of aerial photographs to prepare maps and to plan forest road locations; knowledge of biology to identify plants and animals and to control their growth and reproduction; knowledge of mathematics and biometry to sample and estimate timber and other resources of the forest; and knowledge of economics and business management to evaluate and handle forest properties as business enterprises.

CURRICULUM

The forestry curriculum is broad, but emphasizes a solid background in chemistry, physics, mathematics, biology, humanities and social science. It provides a core of general forestry, part of this core being a 10-week camp program in the summer immediately following the sophomore academic year conducted in the Piedmont and the mountains of North Carolina. In the junior and senior years, there are courses dealing directly with the growing of forests, the management of forest lands, and the economic use of the resources of the forest. At the end of the sophomore year, or the beginning of the junior year, the student chooses one of several areas of specialization and selects appropriate courses to satisfy the credit-hour requirements for that option. Thirty-two credits are provided for the option and free electives.

OPPORTUNITIES

Graduates are in demand by state and federal land-managing agencies, by industrial concerns growing wood as a raw material, and by other organizations and agencies such as the agricultural extension service. Many graduates, after acquiring professional forestry experience, are self-employed as consultants and as operators or owners of forest-related businesses.

FORESTRY CURRICULUM

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 200 Plant Life	4	CH 103 General Chem. II**	4
CH 101 General Chemistry I*	4	ENG 112 Composition & Reading	3
ENG 111 Composition & Rhetoric	3	FOR 210 Dendrology—Gymnosperms	2
FOR 101 (WPS 101) Intro. to		Hum. Soc. Sci. Elective***	3
Forest Res.	1	MA 212 Anal. Geom. & Calc. B	3
MA 112 Anal. Geom. & Cal. A*	4	Physical Education	1
Physical Education	1		16
	17		

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ENG 205 Reading for Discovery	3	EC 212 Economics of Agri.	3
FOR 211 Dendrology—Angiosperms	2	FOR 272 Forest Mensuration	3
PY 211 General Physics	4	PY 212 General Physics	4
WPS 202 Wood Structure & Props.	3	SSC 200 Soils	4
Free Elective	3	Physical Education	1
Physical Education	1		15
	16		

SUMMER CAMP

FOR 204 Silviculture	2
FOR 263 Dendrology	1
FOR 264 Forest Protection	2
FOR 274 Mapping & Mensuration	4
FOR 284 Utilization	1
	10

ALL STUDENTS SELECT AN OPTION BY THE BEGINNING OF THE JUNIOR YEAR AT THE LATEST

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ENT 301 Intro. to For. Insects	3	FOR 452 Silvics	4
ST 311 Intro. to Statistics	3	Hum.—Soc. Sciences Electives***	6
FOR 219 (WPS 219) Forest Ec. & Its Oper.	3	Option Requirements	4
Hum.—Soc. Sci. Elective***	3	Free Elective***	3
Option Requirements	4		17
	16		

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
FOR 405 Forest Land Management	5	FOR 406 Forest Land Inventory	6
Option Requirements	3	and Planning	6
Free Electives***	3	PP 318 (FOR 318) Forest Pathology	3
	16	Option Requirements	7
			16
			Total Hours—139

* The freshman year course offerings as shown here assume that entrance test scores suggest readiness for MA 112 and CH 101. Appropriate substitutions will be made where test scores indicate the need to start at a different level.

** Students planning to take full-year courses in advanced chemistry will take CH 107 in place of CH 103.

*** Electives must include at least 12 credits in humanities or social science; nine credits are completely free of restriction.

FORESTRY FIELDS OF SPECIALIZATION

The fields of specialization (options) in forestry include (a) general forestry, (b) business operations, (c) forest biometry, (d) watershed management, (e) forest biology, (f) wildlife management, (g) harvesting operations, (h) recreation and (i) conservation.

A student selects one of the above fields and schedules the approved courses in that specialization.

DUAL DEGREE PROGRAMS

Programs have been worked out with the Departments of Entomology, Recreation Resources Administration, Soil Science, Zoology, Civil Engineering and Economics whereby interested students can obtain, in addition to the Bachelor of Science degree in forestry, a second Bachelor of Science degree in entomology, natural resource recreation management, soil science, wildlife management, agricultural economics or conservation. These joint programs usually require some additional credits above the option and free elective credits in the forestry curriculum. Superior students can carry these additional credits in the regular four-year program and average students usually can qualify for both degrees by enrolling for an extra semester or equivalent summer sessions.

HONORS PROGRAM

An honors program is also available for students with outstanding records, who may, with the approval of the faculty, substitute a program of advanced studies in lieu of option requirements and certain core courses.

RECREATION RESOURCES ADMINISTRATION

Biltmore Hall

Professor THOMAS I. HINES, *Head of the Department*

Professor: W. E. SMITH; *Adjunct Professor:* T. H. RIPLEY; *Associate Professors:* G. A. HAMMON, L. L. MILLER, C. C. STOTT, R. E. STERNLOFF;

Adjunct Associate Professor: J. S. STEVENS, JR.; *Assistant Professors:* L. W. MONCRIEF, L. W. TOMBAUGH (USDA), M. R. WARREN, JR.; *Adjunct Assistant Professors:* J. H. BRENDLE, JR., J. H. MOSES, E. H. STONE, JR.

Standards that have been adopted by the recreation profession make college graduation a requirement for professional employment in the expanding fields of recreation. It is vitally important for the high school graduate who is planning to enter the recreation profession to select wisely the college or university—one that has the facilities, staff, curriculum, program and an established reputation for comprehensive professional education in recreation and parks education.

The curricula of the Department of Recreation Resources Administration offer a broad general education background, basic professional and technical courses, and the opportunity for a student to specialize in a particular field of recreation. Two curricula are available: Recreation and Park Administration and Natural Resources Recreation Management.

RECREATION AND PARK ADMINISTRATION

Professor THOMAS I. HINES, *In Charge*

The curriculum of recreation and park administration is designed to fulfill the needs of the graduate who will be employed by municipalities, governmental agencies, private agencies, industry and business, and other private groups. The general education requirements include courses in biology, psychology, history and government, English, mathematics, chemistry and economics. Other courses of a more special nature consist of accounting, statistics, research methods, landscape gardening and design. Professional courses, applying directly to the needs of the recreator and his profession cover such topics as recreation, philosophy, management techniques and skills, fiscal operation, supervision, site planning, programming, administration and more.

To provide a student with the opportunity to study the application of recreation to a particular environment, the following options are available.

Employee Option—A background in economics, personnel management and industrial psychology is necessary.

Municipal Parks—Additional courses in applied biology, municipal government and community organization are required.

Institutional—Youth service agencies, corrective institutions and private agencies require that a graduate have emphasis in sociology and psychology.

Public—To satisfy the needs of students planning to be employed by municipalities or counties, additional courses are required in government, community organization and leadership.

RECREATION AND PARK ADMINISTRATION

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 200 Plant Life	4	EC 205 Economic Activity	3
ENG 111 Comp. & Rhetoric	3	ENG 112 Comp. & Reading	3
FOR 101 (WPS 101) Intro. to Forest Res.	1	SOC 202 Prin. of Sociology	3
MA 122 Math of Finance and Elem. Statistics	4	ZO 201 Animal Life	4
RRA 152 Intro. to Recreation	3	Elective	3
Physical Education	1	Physical Education	1
	16		17

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 111 Foundation of Chem.	5	FOR 273 (WPS 273) Quant. Methods in For. Res.	3
English Elective	3	GY 208 Phy. Geog. & Met.	3
Humanity—Soc. Sci. Elective	3	Humanity—Soc. Sci. Elective	3
RRA 215 Main. & Oper. I	3	PSY 200 Intro. to Psychology	3
ZO 221 Conserv. & Nat. Res.*	3	RRA 216 Main. & Oper. II	3
Physical Education	1	Physical Education	1
	<hr/> 18		<hr/> 16

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EC 312 Accounting I	3	HS 342 Landsc. Horticulture	3
Humanities—Soc. Sci. Elective	3	RRA 359 Rec. & Park Supervision	3
LAR 211 Intro. to Lands. Arch.	3	ST 311 Intro. to Statistics	3
RRA 358 The Rec. Program	4	Option Elective	3
Sociology Elective	3	Elective	3
	<hr/> 16		<hr/> 15

Summer Session (9 weeks)

RRA 475 Internship	9
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SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 360 (ZO 360) Intro. to Ecology*	4	RRA 451 Fac. & Site Planning	3
RRA 453 Adm. Poli. & Proc.	3	RRA 454 Rec. & Park Finance	3
SOC 416 Research Methods	3	RRA 491 Special Problems in Rec.	3
Option Elective	3	Option Elective	3
Elective	3	Elective	3
	<hr/> 16		<hr/> 15

Total Hours—138

* Students enrolling in the institutional option must substitute ZO 212, Basic Anatomy and ZO 213, Basic Physiology for ZO 221 and BO 360.

NATURAL RESOURCES RECREATION MANAGEMENT

Biltmore Hall

Associate Professor G. A. HAMMON, In Charge

CURRICULUM

A strong upward trend in natural resource-oriented recreation is evident throughout the Nation. The demand is exceeding the supply in many localities under existing management conditions and constraints, while inadequately managed use in popular locations is contributing toward progressive and unacceptable depreciation of the physical environment and of the recreation opportunities.

Growing pressure on the diminishing resources base is placing a premium on managers who can recognize opportunities, identify problems, conceptualize solutions and implement policies in this field. Specifically needed are highly motivated professionals with strong interdisciplinary backgrounds who are trained to understand the recreation wants and needs of people, and are competent to make sound judgments in planning and managing renewable natural resources for the optimum output of recreation benefits.

It is the intent of this curriculum to provide professional competence in the field of natural resource recreation management for the student who expects to serve with organizations, institutions, agencies or corporations concerned with the preservation, wise use and improvement of recreation resources and

opportunities as they occur in the general forest environment. Students will also be more prepared to serve with public or private agencies primarily concerned with the more intensive phases of public outdoor recreation as they occur on extensive parklands and on other nonurban lands managed for the optimum output of diversified recreation opportunities.

NATURAL RESOURCES RECREATION MANAGEMENT

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 200 Plant Life	4	EC 205 Economic Activity	3
ENG 111 Composition & Rhetoric	3	ENG 112 Composition & Reading	3
FOR 101 (WPS 101) Intro. to Forest Res.	1	MA 212 Anal. Geom. & Cal B	3
MA 112 Anal. Geom. & Cal. A	4	ZO 201 Animal Life	4
RRA 152 Introd. to Recreation	3	Physical Education	1
Physical Education	1		14
	16		

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I	4	CH 103 General Chemistry II	4
ENG 205 Reading for Discovery	3	English Elective	3
PS 201 The American Govt. System	3	FOR 273 (WPS 273) Quant. Meth. in For. Res.	3
PSY 200 Intro. to Psychology	3	PY 221 College Physics	5
SOC 202 Principles of Sociol.	3	Physical Education	1
Physical Education	1		16
	17		

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
FOR 472 Renewable Resource Mgt.	3	BO 403 Systematic Botany	4
RRA 341 Rec. Resource Relation.	3	RRA 440 Rec. Res. Inv. & Plan.	3
SOC 301 Human Behavior	3	SSC 200 Soils	4
ST 311 Intro. to Statistics	3	Controlled Elective	3
Controlled Elective	3	Elective	3
Elective	3		17
	18		

Summer Session (9 weeks)

RRA 475 Internship	9
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SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 360 (ZO 360) Intro. to Ecology	4	RRA 442 Wildland Rec. Environ.	3
RRA 441 Rec. Resource Develop.	3	RRA 454 Rec. & Park Finance	3
Controlled Electives	6	Controlled Electives	6
Elective	3	Elective	3
	16		15

Total Hours—138

WOOD AND PAPER SCIENCE

Biltmore Hall

Professor E. L. ELLWOOD, Head of the Department

Professors: A. C. BAREFOOT, JR., R. M. CARTER, E. B. COWLING, C. A. HART, R. G. HITCHINGS; Adjunct Professors: W. R. SMITH, S. K. SUDDARTH; Professor Emeritus: A. J. STAMM; Associate Professors: K. P. KRINGSTAD, C. G. LANDES, W. T. MCKEAN, R. G. PEARSON, C. N. ROGERS, R. J. THOMAS; Adjunct Associate Professor: P. J. KLEPPE; Extension Associate Professor: L. H. HOBBS; Assistant Professors: HOU-MIN CHANG, R. C. GILMORE, D. H. HOLLEY, D. H. J. STEENSEN; Assistant Professor Emeritus: H. D. COOK; In-

structor: A. G. MULLIN; Teaching Technician: T. GEMMER; Associate Member of the Faculty: V. T. STANNETT (Chemical Engineering); A. PRAK (Industrial Engineering)

EXTENSION

Instructors: S. J. HANOVER, J. S. HEDGECOCK; Instructor and Extension Wood Products Specialist: E. L. DEAL, JR.

The wood industries have been a vital part of the economy of North Carolina for over 300 years. North Carolina ranks first in the nation in the manufacture of hardwood, plywood and wooden furniture, first in the South in rough lumber and railroad tie production and among the leaders in the manufacture of pulp and paper. The value of forest products produced annually in the state exceeds 1.8 billion dollars. Seventeen percent of the state's labor force is employed in the wood industries.

The Department of Wood and Paper Science offers two curricula; wood science and technology, and pulp and paper science and technology, to educate men for careers in the wood based and allied industries or in government agencies concerned with wood resources. The program in wood science and technology is concerned with the technical aspects of wood and its processing into reconstituted and manufactured products. The pulp and paper science and technology program is specifically concerned with wood fibers and their processing for paper and wood based chemicals.

PULP AND PAPER SCIENCE AND TECHNOLOGY

Robertson Laboratory

Professor R. G. HITCHINGS, In Charge

The curriculum in pulp and paper trains men for technical work in the rapidly growing pulp and paper industry. Graduates are prepared for careers as process engineers, product development engineers, technical service engineers, quality control supervisors, control chemists and production supervisors. After a thorough background in the basic sciences, the program offers laboratory work in the specialized Robertson Pulp and Paper Laboratory in wood pulp processes, chemical and by-products recovery, pulp bleaching and in the various paper-making operations, such as refining, sizing, filling, dyeing, formation, coating and the converting of paper.

The pulp and paper industry ranks fifth among all American industries. In 1966, pulp and paper products were valued at \$17 billion and the industry employed more than 640,000 employees. This is primarily a southern industry with over 60 percent of the nation's pulpwood produced in the South.

Financially supported by over 75 company members of the Pulp and Paper Foundation, this program in pulp and paper was created to meet the critical need for trained men in the South. It is a regional program and has been approved by the Southern Regional Education Board as the undergraduate program to serve the Southeast in this field. Approximately 50 undergraduate scholarships are granted annually to students pursuing this field of study. The Reuben B. Robertson Pulp and Paper Laboratory provides this program with outstanding and unique facilities.

All students majoring in this curriculum are required to spend at least one summer working in a pulp or paper mill where arrangements have been made by the University for such employment. Three hours of academic credit are granted the student after completion of 12 weeks of mill work and presentation

of a satisfactory report covering this work experience. In addition to this minimum summer work requirement, students are urged to work in mills the two remaining summers between academic years because of the great value of practical experience in this industry.

This curriculum leads to a degree of Bachelor of Science in pulp and paper science and technology. A minimum of 139 credits is required for graduation. A fifth year program leading to the degree of Bachelor of Science in chemical engineering is available for interested students.

PULP AND PAPER SCIENCE AND TECHNOLOGY CURRICULUM

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BO 200 Plant Life	4	CH 107 Princ. of Chemistry	4
CH 101 Gen. Chemistry I	4	E 101 Eng. Graphics I	2
ENG 111 Comp. and Rhetoric	3	EC 206 The Price System	3
MA 114 Topics in Modern Math*	3	ENG 112 Comp. and Reading	3
WPS 101 (FOR 101) Intro. to Forest Res.	1	MA 112 Analytic Geo. & Calc. A*	4
Physical Education	1	Physical Education	1
	<hr/> 16		<hr/> 17

* Students with adequate background in mathematics are urged to follow a sequence beginning with MA 102 then MA 201 and MA 202.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I	4	CH 223 Organic Chemistry II	4
English Elective	3	English Elective	3
MA 212 Analytic Geo. & Calc. B*	3	PY 212 General Physics**	4
PY 211 General Physics**	4	WPS 342 Fiber Analysis	3
Social Science Elective	3	Elective	3
Physical Education	1	Physical Education	1
	<hr/> 18		<hr/> 18

SUMMER SESSION

WPS 491	3
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JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 315 Quantitative Analysis	4	CH 331 Intro. Physical Chem.	4
CHE 301 Elements of Ch. Engr.	3	CHE 302 Elements of Chem. Engr.	3
MAE 307 Energy & Energy Trans.	3	PSY 200 Intro. to Psychology	3
Social Science Elective	3	WPS 322 Pulp & Paper Tech.	3
WPS 321 Pulp & Paper Tech.	3	Elective	3
	<hr/> 16		<hr/> 16

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
WPS 411 Pulp & Paper Unit Processes	3	WPS 403 Paper Process Anal.	3
WPS 413 Paper Properties & Additives	4	WPS 412 Pulp & Paper Unit Proces.	3
WPS 417 Pulping Process Analysis	4	WPS 461 Paper Converting	1
WPS 491 (FOR 491) Senior Problems	1	WPS 463 Plant Inspections	1
WPS 521 Chem. of Wood & Wood Prod.	3	WPS 482 Pulp & Paper Mill Mgmt	2
Electives	3	WPS 522 Chem. of Wood & Wood Prod.	3
	<hr/> 18	Electives	4
			<hr/> 17

Total Hours—139

** Students with adequate backgrounds should take PY 205, 208.

WOOD SCIENCE AND TECHNOLOGY

Professor E. L. ELLWOOD, *In Charge*

CURRICULUM

The purpose of the curriculum is to instruct students in the nature of wood as a natural resource and its processing by means of a systematic study of the properties of wood and the processes involved in its utilization and manufacture.

The curriculum has been designed to provide a high degree of flexibility to enable students to specialize in areas of their special interests as they apply to the wood science and technology field. Following a sound coverage in mathematics and the natural sciences, a materials science approach to wood is developed concurrently with training in the processing technology of wood and wood based products and in decision making applied to wood product manufacturing.

At the end of the sophomore year students attend a six-week wood process laboratory practicum in the Brandon P. Hodges Wood Products Laboratory. Following this laboratory students undertake an internship in industry or in institutional research to develop practical experience.

During the final two years of the program students choose a minor, or option, in another discipline outside of the department.

OPPORTUNITIES

The curriculum prepares graduates for positions in the wood industries, trade associations, or government agencies in such areas as, technical service, research and development, quality control, marketing, or management in the production of lumber, veneer and plywood, particle and fiber boards, dimension stock, millwork, furniture, and many other wood based enterprises. Additionally, opportunities for graduates exist in associated and supplier firms to the wood industries such as chemical and machinery companies.

WOOD SCIENCE AND TECHNOLOGY CURRICULUM

Freshman Year

CH 101 General Chem. I	4	BS 100 General Biol.	
ENG 111 Composition & Rhet.	3	or	
FOR 101 (WPS 101) Intro. to For Res.	1	BO 200 Plant Life	4
MA 112 Anal. Geom. & Cal. A*	4	CH 103 General Chem. II	4
Social Science Elec.	3	ENG 112 Comp. & Reading	3
Physical Education	1	MA 212 Anal. Geom. & Calc. B*	3
		Physical Education	1
	16		15

Sophomore Year

EC 206 The Price System		Social Science Elective	3
or		WPS 203 Wood Struct. & Prop. II	3
EC 212 Economics of Agri.	3	WPS 273 (FOR 273) Quantitative Meth.	
PY 221 College Physics	5	in Forest Resources	3
Social Science Elective	3	Option Elective	3
WPS 202 Wood Struct. & Prop. I	3	Free Elective	3
Physical Education	1	Physical Education	1
	15		16

Summer Practicum

WPS 205 Wood Machining Prac.	1
WPS 206 Wood Drying Prac.	1
WPS 207 Gluing Prac.	1
WPS 208 Wood Finishing Prac.	1
WPS 209 Plant Inspections Prac.	1
WPS 210 Forest Prod. Internship	1

Junior Year

Social Science Elec.	3	Social Science Elective	3
ST 361 Intro. to Stat. for Engr. I	3	WPS 302 Wood Processing II	3
WPS 301 Wood Processing I	3	WPS 344 Intro. to Qual. Cont.	3
WPS 320 Wood Products Chem.	3	WPS 491 (FOR 491) Senior Prob.	
Option Elective	3	in For. Res.	1
	15	Option Elective	3
		Free Elective	3
			16

* Students with mathematical aptitude and interest are encouraged to substitute MA 102, MA 201 and MA 202 for the mathematical sequence listed.

Senior Year

Social Science Elective	3	WPS 435 Systems Analysis in	
WPS 434 Wood Operations I	3	Forest Products	3
WPS 441 Intro. to Wood Mech.	2	WPS 442 Wood Mechanics & Design	3
WPS 492 (FOR 492) Senior Prob.		Option Electives	6
in For. Resources	2	Free Elective	3
Option Electives	5		15
	15		

Total credit hours including summer practicum and internship—129

FIELDS OF SPECIALIZATION

The program provides the opportunity for students to minor (option) in a discipline outside of the department to the extent of a minimum of 20 credit hours. These options enable the student to develop a second area of concentration of his choice which can be applied to the field of wood science and technology and which can also provide a base for subsequent graduate work in wood science and technology or in the option area selected. Options are available in, a) economics, b) quantitative analysis, c) biology and biochemistry, d) chemistry, e) harvesting operations and f) political science. Options other than those listed also may be arranged through the department.

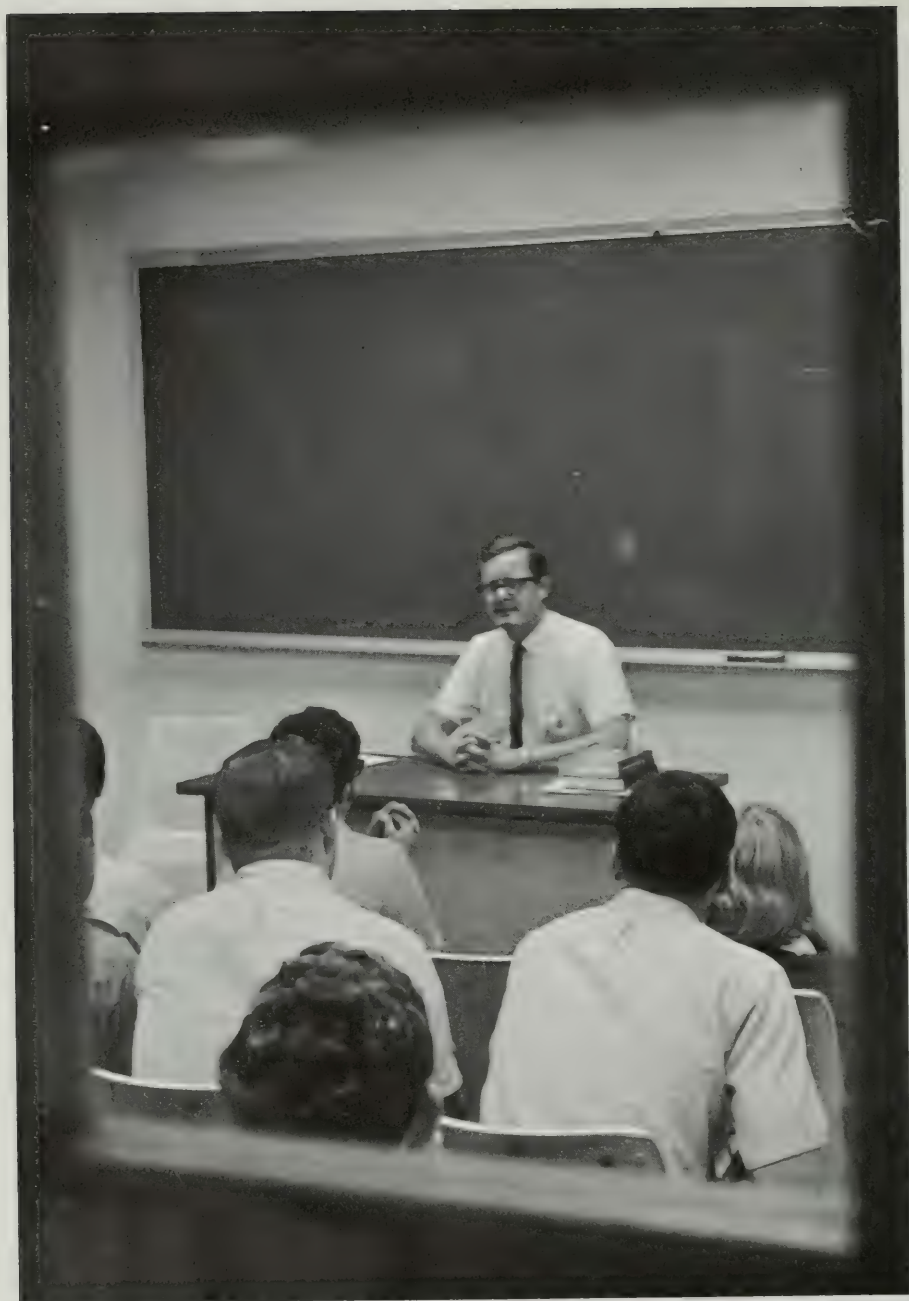
DUAL DEGREE PROGRAM

A dual degree program has been prepared jointly with the Department of Economics whereby interested students can obtain, in addition to a Bachelor of Science in wood science and technology, a second Bachelor of Science in economics.

This program does require some additional credits beyond those required for the regular single degree program but capable students can usually complete the necessary additional credits within the four years of the regular undergraduate program.

HONORS PROGRAM

An honors program is also available for students with outstanding records, who may, with the approval of the faculty, substitute a program of advanced studies in lieu of option requirements and certain core courses.



Through classroom work as well as individual study, a liberal arts major can learn to apply his general knowledge.

LIBERAL ARTS

FRED V. CAHILL, *Dean*

The School of Liberal Arts offers programs of study which lead to the baccalaureate and advanced degrees in the disciplines comprising the humanities and social sciences and also offers courses in these areas which are part of the programs of all undergraduate students in the University.

In making this work available to its students, the University provides an opportunity for its students to prepare for a full life in many professions and occupations which require flexibility, broad knowledge and a basic comprehension of human beings and their problems.

Eight departments are included in the School of Liberal Arts: economics (also a department in the School of Agriculture and Life Sciences), English, history, modern languages, philosophy and religion, physical education, politics, and sociology and anthropology (also a department in the School of Agriculture and Life Sciences). Areas of concentration (majors) on the undergraduate level are: economics, English, history, modern languages, philosophy, politics, sociology, and speech-communications. Degrees granted include the Bachelor of Arts, the Bachelor of Science, the Master of Arts and the Doctor of Philosophy, in addition to professional degrees in economics, politics and sociology. Teacher certification is available in the areas of English and social studies.

In all undergraduate programs a minimum average of C in the major is required and in the Bachelor of Science program the student must maintain a C average both in his major and in his scientific or technical option.

Students transferring from junior colleges are limited to 64 transfer credits plus physical education.

BACHELOR OF ARTS DEGREE

A sample program of studies satisfying the requirements of the degree of Bachelor of Arts is set out below. Majors are available in economics, English, history, modern languages, philosophy, politics, sociology and speech-communications. It should be emphasized that the program is illustrative only; with few exceptions the requirements can be satisfied in a variety of ways. In addition to the general University requirements, the student must present at least two units of a modern foreign language upon entrance.

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ENG 111 Composition and Rhet.	3	ENG 112 Comp. and Reading	3
HI 101 History of Civ.	3	HI 102 Hist. of Civ.	3
Mathematics*	3-4	Mathematics*	3-4
Modern Language 201 (Interm.)	3	Modern Language 202 (Interm.)	3
Social Science**	3	Social Science**	3
Physical Education	1	Physical Education	1
	<hr/> 16-17		<hr/> 16-17

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Literature***	3	Literature***	3
Natural Science***	4-5	Natural Science***	4-5
PHI 205 Prob. & Types of Phil.	3	Social Science	3
Social Science	3	Electives	3
Elective	3	Physical Education	1
Physical Education	1		<hr/> 17-18
	<hr/> 17-18		

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Natural Science****	4	Major	9
Major	6	Electives	6
Electives	6		15
	16		

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Major	9	Major	6
Electives	6	Electives	9
	15		15

Total Hours—124

* MA 115, 116 or MA 111, 112

** EC 205, 206; PS 201, 206, 301, 322; PSY 200, 210; SOC 202, 301; ANT 251, 252. Two of the required four courses must be in departmental sequence.

*** ENG 261, 262; 265, 266; ML 301, 302.

**** A three-semester program including PY 231, CH 111 and BS 100 or an equivalent program consisting of a two-semester sequence in physics, chemistry or biology (e.g., PY 211, 212, CH 101, 103, BS 100, ZO 201 or BO 200) plus one additional course in either of the two remaining disciplines.

BACHELOR OF SCIENCE DEGREE

The curriculum leading to the degree of Bachelor of Science features a double concentration: one in economics, English, history, philosophy, politics and another in a basic science, mathematics or technology. A "C" average must be attained in each. It will be to the advantage of the student to present at least four units of mathematics upon entrance. He must present at least two units of a modern foreign language.

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I	4	CH 103 General Chemistry II	4
ENG 111 Comp. and Rhetoric	3	ENG 112 Comp. and Reading	3
MA 111 Algebra and Trig.	4	MA 102 Anal. Geo. & Calc. I	4
Modern Language 201 (Interm.)	3	Modern Language 202 (Interm.)	3
Physical Education	1	PHI 205 Problems and Types of Phil.	3
	15	Physical Education	1
			18

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ENG 205 Reading for Discovery	3	History or Social Science	3
History or Social Science	3	MA 202 Anal. Geo. and Calc. III	4
MA 201 Anal. Geo. and Calc. II	4	PY 208 Gen. Physics	4
PY 205 Gen. Physics*	4	or	
or		PY 212 Gen. Physics	3
PY 211 Gen. Physics*	3	Elective	3
Physical Education	1	Physical Education	1
	15		15-16

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
BS 100 General Biology	4	Philosophy of Science***	3
History of Science	3	Course III—Humanities or Social Science Concentration	3
Course I—Humanities or Social Science Concentration	3	Course IV—Humanities or Social Science Concentration	3
Course II—Humanities or Social Science Concentration	3	Course II—Advanced Technical or Science Option	3-4
Course I—Advanced Technical or Science Option	3-4	Zoology or Botany	4
	16-17		16-17

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Course V—Social Sciences or Humanities Concentration	3	Course VI—Social Sciences or Humanities Concentration	3
Course III—Advanced Technical or Science Option	3-4	Course IV—Advanced Technical or Science Option	3-4
Humanities or Social Science Elective ...	3	Humanities or Social Science Elective ...	3
Elective	3	Elective	6
Seminar	3	Seminar	3
	15-16		18-19

Total Hours—126-133

* May be switched with biology if further work in biology is anticipated.

** MA 112, 114, and 212 may be substituted for MA 102, 201, 202.

*** SS 301, 302 satisfies this requirement.

JOINT LIBERAL ARTS-ENGINEERING PROGRAM

Some students may want to take advantage of the opportunity to combine a B.S. in engineering with either a B.S. or B.A. in liberal arts. When the two are carried along together the double degree program can be completed in five years. Those interested should contact the Freshman Engineering Division and the Dean of Liberal Arts.

ECONOMICS

(Also see agriculture and life sciences.)

Patterson Hall

Professor W. D. TOUSSAINT, Head of the Department

TEACHING AND RESEARCH

Professors: A. J. BARTLEY, A. J. COUTU, D. M. HOOVER, L. A. IHNNEN, H. B. JAMES, P. R. JOHNSON, R. A. KING, J. G. MADDOX, B. M. OLSEN, J. A. SEAGRAVES, R. L. SIMMONS, T. D. WALLACE, J. C. WILLIAMSON, JR., T. W. WOOD; *Research Professor:* J. G. SUTHERLAND (USDA); *Adjunct Professor:* D. R. DIXON; *Professor Emeritus:* E. W. SWANSON; *Associate Professors:* D. S. BALL, J. S. CHAPPELL, W. M. CROSSWHITE, M. M. EL-KAMMASH, E. W. ERICKSON, R. M. FEARN, C. W. HARRELL, JR., E. W. JONES, C. H. LITTLE, F. A. MANGUM, G. A. MATHIA, E. C. PASOUR, JR., R. J. PEELER, JR., R. A. SCHRIMPER, R. E. SYLLA, C. B. TURNER, J. W. WILSON; *Assistant Professors:* J. B. BULLOCK, G. A. CARLSON, L. M. ENNIS, JR., B. L. GARDNER, H. C. GILLIAM, JR. (USDA), T. J. GRENNES, D. N. HYMAN, C. P. JONES, J. S. LAPP, J. C. MATTHEWS, JR., M. B. McELROY, D. F. NEUMAN, R. K. PERRIN, J. C. POINDEXTER, H. A. SANDMAN; *Visiting Assistant Professor:* R. L. TINNERMEIER; *Assistant Professor Emeritus:* O. G. THOMPSON; *Instructors:* J. D. ACKER, C. H. BAKER, A. M. BEALS, JR., R. R. MCBURNEY, JR., W. P. PINNA, R. C. REINOSO, LEAH J. SMITH, M. W. SMITH, R. H. WILLIAMSON, ANN D. WITTE; *Special Lecturers:* M. A. HUNT, R. J. SZAL; *Research Assistant:* F. V. HARRELL, JR.

EXTENSION

Professor C. R. PUGH, In Charge of Farm Management and Public Affairs

Professors: W. L. TURNER, C. R. WEATHERS; *Associate Professors:* J. G. ALLGOOD, D. G. HARWOOD, H. L. LINER, R. C. WELLS; *Assistant Professor:* P. S. STONE; *Instructor:* D. C. PARDUE

Professor G. L. CAPEL, In Charge of Marketing Economics

Professors: T. E. NICHOLS, JR., E. A. PROCTOR; Associate Professors: R. S. BOAL, R. C. BROOKS, L. H. HAMMOND, H. A. HOMME; Assistant Professors: J. E. IKERD, E. M. STALLINGS, RUBY P. UZZLE

The general objective of the program in economics is to develop in the student such critical and analytical skills as underlie the ability to understand economic problems and institutions, both in their historical setting and under conditions of change. The curriculum furnishes the academic background necessary for many positions in industry, government service and graduate work in economics and the social sciences. Specifically, the program in economics seeks a) to impart an understanding of human and institutional economic behavior; b) to teach the student how to approach economic propositions through the use of theoretical and empirical analysis, and c) to confront the student with contemporary issues and alternative socio-economic policy considerations.

The Department of Economics offers programs in several fields of economics at both the undergraduate and graduate levels of study. The department is administered jointly by the School of Agriculture and Life Sciences and the School of Liberal Arts. For information on the field of agricultural economics see pages 91-94 under agriculture and life sciences.

The department also has a major service function to perform for the various technical schools, and several curricula offer a minor program in economics.

FACILITIES

The department has a modern and well-equipped library including technical reference books, major professional journals and government publications. Research publications from other institutions throughout the United States are kept on file. Graduate students in economics are provided office space and research equipment. Computational facilities are available for students whose research problems involve extensive analysis of data, as well as for those students who want to learn to use computer facilities. The department has a well-trained clerical staff and maintains an IBM 1050 Terminal connected to an IBM 360/System Model 75 operated by the Triangle University Computational Center. Access is also available to an IBM 1130 and a 360/System Model 40 located on the University campus.

BACHELOR OF ARTS DEGREE

The Bachelor of Arts degree with a major in economics consists of 33 hours in the prescribed and elected courses. Of these 18 hours are required as the core. The remaining 15 hours of electives are divided between nine hours of restricted and six hours of unrestricted electives in economics.

	<i>Credits</i>		<i>Credits</i>
EC 205 Economic Activity	3	EC 317 Introduction to Methods of	
EC 206 The Price System	3	Economic Analysis*	3
EC 301 Production and Prices	3	EC 490 Senior Seminar in Economics	3
EC 302 National Income and		Economic Electives (Restricted	
Economic Welfare	3	and Unrestricted)	15
		TOTAL	33

* ST 311, 361 or 371 may be substituted for EC 317.

BACHELOR OF SCIENCE DEGREE

The Bachelor of Science degree with a major in economics consists of 27 hours in the prescribed and elected courses. Of these 15 or 18 hours are required as the core. Nine of the remaining hours must consist of restricted electives in economics.

	<i>Credits</i>		<i>Credits</i>
EC 205 Economic Activity	3	EC 317 Introduction to Methods of	
EC 206 The Price System*	3	Economic Analysis**	3
EC 301 Production and Prices	3	EC 490 Senior Seminar in Economics	3
EC 302 National Income and		Economic Electives (Restricted)	9
Economic Welfare	3	TOTAL	27

* EC 206 may be waived subject to the approval of the student's faculty adviser.

** ST 311, 361 or 371 may be substituted for EC 317.

ELECTIVE COURSES

Students must complete at least two courses selected from a specified list of restricted economics electives and one of the basic statistics courses before enrolling in EC 490 in order to provide the tools and the broad perspective necessary for independent study.

Restricted and unrestricted economics electives may be taken in a particular area of concentration, although a concentration is not mandatory, and the student and his adviser may work out a special group of electives. Some of the alternative concentrations are as follows:

Managerial Economics—Accounting I; Industrial Management; Personnel Management; Industrial Relations, and Management Policy and Decision Making.

Marketing and Demand—Marketing Methods; Agricultural Price Analysis; Labor Economics; International Economics, and Markets and Trade.

Growth and Development—The Rise of Industrialism; Economics of Development; International Economics; Evolution of the American Economy, and Comparative Economic Systems.

Welfare and Policy—Competition, Monopoly and Public Policy; Labor Economics; Evolution of Economic Ideas; International Economics, and Public Finance.

Finance—Accounting I and II; Financial Institutions; Tax Accounting, and Corporation Finance.

GRADUATE STUDY

The Department of Economics offers programs of study leading to the Master of Economics, the Master of Arts in economics, the Master of Science in agricultural economics, and the Doctor of Philosophy degrees. Prospective applicants should consult the Graduate School Catalog.

ENGLISH

Winston Hall

Professor LODWICK HARTLEY, *Head of the Department*

Professor LARRY S. CHAMPION, *Associate Head of the Department*

Professors: H. G. KINCHELOE, B. G. KOONCE, JR., F. H. MOORE, JR., G. OWEN, JR., C. A. PARKER, R. G. WALSER; *Associate Professors:* L. J. BETTS, JR., P. E. BLANK, JR., L. R. CAMP, E. P. DANDRIDGE, JR., P. H. DAVIS, J. B. EASLEY, W. G. FRANKLIN, M. HALPEREN, A. S. KNOWLES, JR., N. G. SMITH, L. H. SWAIN, W. B. TOOLE, III, R. B. WHITE, JR., P. WILLIAMS, JR., R. B. WYNNE; *Assistant Professors:* J. W. CLARK, JR., H. A. HARGRAVE, C. P. HEATON, R. A. LASSETER, III, W. E. MEYERS, CATHERINE E. MOORE, D. K. ORBAN, CORA L. ROBEY, S. SCOVILLE, JEAN J. SMOOT, A. F. STEIN, T. N. WALTERS, H. C. WEST, MARY C. WILLIAMS; *Instructors:* JUDITH H. BOLCH, E. G. CONE, VIRGINIA C. DOWNS, D. M. GOLDSBERRY, W. E. HASKIN, E. L.

HEAD, L. L. HOGUE, DEL MARIE HUNT, MARGARET A. JACKSON, SHERROLYN MAXWELL, M. S. REYNOLDS, NANCY B. RICH, J. M. ROBERTSON, D. D. SHORT, MARILYN M. UPCHURCH; *Special Lecturers*: G. W. BARRAX, AUDREY H. BRADLEY

The Department of English offers both basic and advanced courses in composition, speech, language and literature. The freshman courses, common to all curricula and prerequisite to all advanced courses in English, are designed to give intensive training and practice in written communication, plus an introduction to literary types. Courses in communication of technical information, in creative and advanced expository writing, and in speech are offered to meet course requirements in special curricula and to provide electives for interested students. Advanced courses are available for a major in literature, a major in speech-communication in the Bachelor of Arts program, and a concentration in literature and in communications in the Bachelor of Science program, as well as for general electives.

MAJOR IN ENGLISH

For the English major in the Bachelor of Arts program the student must schedule 30 semester hours beyond the usual six hours in freshman composition. Basic requirements include the sophomore survey of English literature, a course in Shakespeare, and at least one course in American writers. Beyond these courses, the student may pursue his special interests within the limits of two recommended categories. In the final semester, a special seminar will serve as a capstone to his study. For a teaching certificate, 18 hours in professional courses and practicum must be included.

For students electing the Bachelor of Science program with English as an area of concentration, eight courses and seminars above the basic freshman and sophomore courses will be selected with the aid of departmental advisers.

MAJOR IN SPEECH-COMMUNICATION

The major in speech-communication in the Bachelor of Arts program includes 30 semester hours. SP 230, Fundamentals of Speech, may be taken for credit, but cannot be counted for the major. The curriculum in speech-communication requires four prescribed courses in speech and the usual senior seminar designed to culminate study in the discipline. In addition, the student may elect courses within the field from among offerings in rhetoric and public address, oral interpretation, drama and radio-television to complete the 30-hour requirement. For a teaching certificate, a more prescribed curriculum is necessary and in addition 18 hours in professional courses and practicum must be included.

GRADUATE STUDY IN ENGLISH

In addition to the Bachelor's programs above, the Department of English offers the Master of Arts degree with concentration in English or American literature. The program is designed either to provide the student with a terminal course of study or to serve as the first year toward the doctorate. Prospective applicants should consult the Graduate School Catalog.

HISTORY

Harrelson Hall

Professor R. W. GREENLAW, Head of the Department

Professor L. W. SEEGER, Assistant Department Head

Professors: B. F. BEERS, M. L. BROWN, JR., DORIS E. KING, S. M. NOBLIN;

Adjunct Professor: H. G. JONES; *Associate Professors:* M. S. DOWNS, R. N. ELLIOTT, W. C. HARRIS, J. M. RIDDLE, S. S. SUVAL; *Assistant Professors:* D. C. BAILEY, C. H. CARLTON, J. P. HOBBS, C. F. KOLB, JUDITH P. PULLEY, R. A. ROTZ, JR., EDITH D. SYLLA, MARY E. WHEELER; *Instructors:* J. R. BANKER, G. GRAN, H. D. METZGAR, JR.

An understanding of the historical background of our times is expected of the educated man. The Department of History makes it possible for students to gain this understanding by offering a wide range and variety of courses at all levels from introductory through graduate. Appropriate selection of these may be made for a major program. Most of them can be selected as electives in the various curricula of the University.

Students who demonstrate a satisfactory proficiency in World history are permitted to take 200-level courses in history instead of the 100-level introductory courses required by the Schools of Engineering, Liberal Arts, Agriculture and Life Sciences, and Physical and Mathematical Sciences. Students may qualify for exemption from 100-level courses and substitution of 200-level courses by attaining a satisfactory score on the College Entrance Examination Board European History and World Cultures Achievement Test, or on a placement test administered by the history department at summer orientation sessions.

The department also participates in the Fort Bragg program and cooperates with the Division of Continuing Education by making selected courses available to adults who do not reside on the North Carolina State campus.

MAJOR IN HISTORY

B.A. Degree Program—A history major must take 30 hours of course work in history in addition to the six hours required of all students in the School of Liberal Arts. These 30 hours must include at least six hours of United States history as well as the senior history seminar, HI 492. At least 18 hours of the 30 must be at the 300 level or above, and at least 15 hours must be taken in residence at North Carolina State University.

TEACHING MAJOR IN HISTORY

B.A. Program with Teacher Certification—The requirements for the teaching major in history are the same as those for the regular major, except for the addition of the professional courses in education required for teacher certification. Those desiring to enter this program should declare their intention by the spring of the sophomore year. Recipients of B.A. degrees under this program receive state certification as teachers of social studies at the secondary level.

CONCENTRATION IN HISTORY

B.S. Program—A concentration in history will involve 18 hours of course work beyond the six hours required of all students in the School of Liberal Arts, plus the senior seminar, HI 492. Of the 18 hours, six must be in United States history, and at least 12 must be at the 300 level or above.

MODERN LANGUAGES

Harrelson Hall

Professor G. W. POLAND, *Head of the Department*

Professor: E. M. STACK; *Associate Professors:* F. J. ALLRED, GLORIA M. FRY, MARY PASCHAL, H. TUCKER, JR.; *Assistant Professors:* T. P. FEENY, G. GON-

HALES, D. R. KLOE, VIRGINIA M. PRICHARD, C. R. REYNOLDS, E. W. ROLLINS, JR., S. E. SIMONSEN, VIRGINIA S. SMITH; *Instructors*: E. E. BEAN, N. T. DILL, W. M. HOLLER, KAYE HUGHES, J. L. IVEY, W. KOSMIN

The Department of Modern Languages provides instruction in French, German, Spanish, Italian and Russian as well as special instruction in English for foreign students. In addition to elementary grammar, courses are offered in the literature and culture of these language areas. A language laboratory provides further opportunity to students to improve aural-oral skill in a target language.

For a major in French or Spanish in the Bachelor of Arts program, 30 hours beyond the six hours of elementary language are required. There is an additional requirement of a minimum of 12 hours in a second language. Aside from this 12-hour requirement, the normal requirements for a Bachelor of Arts in liberal arts must be met. Majors desiring a teaching certificate must take required courses in education and psychology.

There are also special courses for graduate students preparing to fulfill language requirements for advanced degrees. For graduate students already having a reading knowledge of a foreign language, examinations for certification are given.

PHILOSOPHY AND RELIGION

Harrelson Hall

Professor R. S. BRYAN, Head of the Department

Professor: P. A. BREDENBERG; *Professor Emeritus*: W. N. HICKS; *Associate Professors*: W. L. HIGHFILL, R. S. METZGER, J. L. MIDDLETON; *Visiting Associate Professor*: D. W. SHRIVER, JR.; *Assistant Professors*: W. C. FITZGERALD, JR., T. H. REGAN, A. D. VANDEVEER; *Instructors*: W. KURYLO, M. P. O'NEIL

The function of the Department of Philosophy and Religion at North Carolina State University is twofold. (1) It serves the needs of the University at large by providing courses devoted to the discussion of the great philosophic ideas of western civilization and of the religious notions which have had an impact on all of civilization, and (2) it provides an opportunity for extensive technical study in philosophy for those students who wish to concentrate in this field either for its own sake or as an ideal intellectual foundation for subsequent graduate or professional study.

Programs leading to two degrees in philosophy, the Bachelor of Arts and the Bachelor of Science, are offered by the department. Candidates for the Bachelor of Arts degree in philosophy must complete 30 hours in philosophy beyond the introductory course, Problems and Types of Philosophy (PHI 205). These must include either Elementary Logic (PHI 201) or Symbolic Logic (PHI 401); the courses in the development of western philosophic thought (PHI 300, 317, and 318); and a seminar (PHI 490 or 491). Candidates for the Bachelor of Science degree must include PHI 401.

PHYSICAL EDUCATION

Carmichael Gymnasium

Professor F. R. DREWS, Head of the Department

Professors Emeriti: P. H. DERR, J. F. MILLER; *Associate Professors*: J. L. CLEMENTS, J. B. EDWARDS, JR., A. M. HOCH, H. KEATING, W. R. LEONHARDT,

W. H. SONNER; *Assistant Professors*: D. C. ADKINS, N. E. COOPER, J. M. DANIELS, W. P. MARLEY, M. S. RHODES, W. M. SHEA, ELIZABETH A. SMALTZ, R. G. WEAVER; *Instructors*: J. W. BARKER, G. R. BOETTNER, J. CANDLER, R. G. GWYNN, J. W. ISENHOUR, JR., BERTHA E. PALMATEER; *Lecturer*: MARGARET G. WESCOTT

North Carolina State University requires from two to four semesters in physical education to be taken consecutively during the freshman and sophomore years. The specific number of semesters of required physical education is determined for each student by the Department of Physical Education based on physical fitness testing and individual interests. Insofar as staff, facilities and allotment of time will permit, each student is guided into courses which will best meet his individual needs.

PRESCRIBED COURSES

Prescribed courses are designed to meet the specific needs of the students as determined by tests. The prescribed courses offered are: Health and Physical Fitness, Beginning Swimming I, Beginning Swimming II, Restricted Activity I and Restricted Activity II. The Health and Physical Fitness course is required of all new freshmen. The Department of Physical Education also requires a demonstrated survival swimming ability or placement in the appropriate Beginning Swimming course.

CONTROLLED ELECTIVE COURSES

All elective courses are grouped under one of the following areas: aquatics, combatives, developmental activities, individual sports and team sports. Students are encouraged to develop proficiency in at least two vigorous life-time sports.

POLITICS

Harrelson Hall

Professor W. J. BLOCK, Head of the Department

Professors: F. V. CAHILL, J. T. CALDWELL, A. HOLTZMAN; *Visiting Professor*: B. HAYS; *Associate Professors*: H. G. KEBSCHULL, K. S. PETERSEN; *Assistant Professors*: L. E. BENNETT, W. G. ELLIS, J. H. GILBERT, J. M. MCCLAIN; *Visiting Assistant Professor*: EVA R. RUBIN; *Instructors*: HOPE M. BROGDEN, T. M. BROWNLEE, J. P. MASTRO, M. S. SOROOS, J. O. WILLIAMS, D. R. WIRE

The Department of Politics offers both basic and advanced courses in all major fields of the discipline: American government and politics (local, state and national), comparative government and politics, international relations and organizations, political theory, public administration, and scope and methods of political science. Although the department provides an area in which students may concentrate their major efforts, it also affords opportunities for the study of government and administration to students in other curricula and schools and to students at Fort Bragg. Graduate courses in politics are available to students seeking advanced degrees in other curricula.

The department conducts a State Legislative Internship Program in alternate years. It also participates in the State Government Internship Program, which functions under the sponsorship of the Institute of Government at Chapel Hill.

MAJORS IN POLITICS

B.A. Program—A major in politics requires 30 hours of course work in the discipline, including PS 200, Introduction to Politics; PS 491, 492, Seminar in Politics, and a course in early or modern political theory. Students are expected to include in their programs advanced courses in at least three of the fields in the discipline, although they may concentrate their work in one field.

The department recommends that its majors, whenever practicable, take MA 111, 112 in fulfillment of the two-semester mathematics requirement in the School of Liberal Arts.

CONCENTRATION IN POLITICS

B.S. Program—A concentration in politics requires 24 hours of course work in the discipline, including PS 200, Introduction to Politics, and PS 491, 492, Seminar in Politics.

GRADUATE STUDY

The Department of Politics offers the Master of Arts degree in politics and the Master of Public Affairs degree. Prospective applicants should consult the Graduate School Catalog.

SOCIOLOGY AND ANTHROPOLOGY

(Also see Agriculture and Life Sciences)

1911 Building

Professor S. C. MAYO, Head of the Department

TEACHING AND RESEARCH

Professors: C. H. HAMILTON, C. P. MARSH, G. C. McCANN, J. N. YOUNG; *Associate Professors:* H. G. BEARD, A. C. DAVIS, L. W. DRABICK, C. V. MERCER, H. D. RAWLS, M. M. SAWHNEY, ODELL UZZELL; *Visiting Associate Professor:* H. D. HOLDER; *Adjunct Associate Professors:* W. J. BUFFALOE, R. L. ROLLINS, JR.; *Assistant Professors:* R. C. BRISSON, T. E. CLARK, W. B. CLIFFORD, III, D. F. COLLINS, C. G. DAWSON, G. L. FAULKNER, T. M. HYMAN, R. L. MOXLEY, R. D. MUSTIAN, ELIZABETH M. SUVAL, PATRICIA L. TOBIN; *Visiting Research Assistant Professor:* IDONNA E. RUSSELL; *Instructors:* HELEN P. CLARKSON, G. S. NICKERSON, J. G. PECK, BETTY H. WISER; *Associate Members of the Faculty:* R. J. DOLAN (Adult Education); L. W. MONCRIEF (Recreation Resources Administration)

EXTENSION

Assistant Professor J. K. COLLINS, In Charge of Community Development

Professor: J. D. GEORGE; *Professor Emeritus:* J. W. CRAWFORD; *Assistant Professors:* T. N. HOBGOOD, JR., C. E. LEWIS, P. P. THOMPSON; *Community Development Specialists:* V. E. HAMILTON, D. R. PROCTOR

The major aim of this department is to teach students the principles and techniques for understanding human group behavior. More specifically the department seeks: (1) to train students to become leaders in organizing groups

and communities and in administering their programs; (2) to qualify exceptional students on the undergraduate and graduate levels for sociological research, teaching and extension work; (3) to solve problems in human group relations through scientific research and (4) to extend research results to the people of the State.

BACHELOR OF ARTS DEGREE

The following departmental requirements must be met by all students majoring in sociology: a minimum of 30 hours in the major field including SOC 202, Principles of Sociology; SOC 301, Human Behavior; SOC 315, Social Thought; SOC 416, Research Methods; a minimum of five electives on the 300 or higher level in sociology; and one semester of SOC 490, Senior Seminar. The department also requires ANT 252, Cultural Anthropology, at least one course in psychology and one elective in statistics.

GRADUATE STUDY

The Master of Science, Master of Sociology and Doctor of Philosophy degrees are offered by this department. Prospective applicants should consult the Graduate School Catalog.

SPEECH-COMMUNICATION

(See English)

UNIVERSITY STUDIES

Harrelson Hall

Professor J. R. LAMBERT, JR., Acting Head

*Associate Professor: J. C. WALLACE; Assistant Professor: R. M. CORNISH;
Visiting Assistant Professor: R. J. CLACK; Instructors: R. L. HOFFMAN,
R. T. SCOTT, C. L. STALNAKER*

University Studies is a newly-instituted educational program offering undergraduate courses that are problem or issue oriented and that are taught in an interdisciplinary format. Courses are open on an elective basis to students in all curricula without course prerequisites. Faculty is drawn from the various disciplines directly concerned with the problems or issues under consideration.

For the present the Division of University Studies will offer the courses previously taught by the Department of Social Studies.



The new nine-story Dabney Hall provides modern equipment for the study of chemistry.

PHYSICAL AND MATHEMATICAL SCIENCES

Cox Hall

ARTHUR CLAYTON MENIUS, JR., *Dean*

JASPER DURHAM MEMORY, *Assistant Dean*

The demand for high caliber scientists, mathematicians and engineers continues to outpace the national supply. The need for persons trained in these areas has been a contributing factor in the growth of the School of Physical and Mathematical Sciences since its inception in 1960. The school performs a three-fold function: the training of potential scientists and mathematicians; the technical support of curricula in agriculture and life sciences, design, education, engineering, forest resources, liberal arts and textiles; and research in physical sciences and mathematics. These activities are carried out by the seven academic Departments of Biochemistry, Chemistry, Computer Science, Statistics, Geosciences, Mathematics and Physics. The Institute of Statistics (Raleigh section), and the Department of Physical Sciences Research are also associated with the School of Physical and Mathematical Sciences. The graduates of the school are actively recruited for technical and administrative positions in industrial research and development laboratories, universities and colleges, nonprofit research organizations and government agencies. A large percentage of the graduates undertake advanced study leading to the Master of Science and Doctor of Philosophy degrees. A lifetime of challenge and opportunity is offered to students who choose these curricula of study.

The high-school student with an above-average performance in mathematics, chemistry or physics, and a basic interest in natural phenomena and their mathematical descriptions, is encouraged to consider a career in physical sciences or mathematics. Both ability and motivation are essential prerequisites for successful completion of the bachelor's degree requirements. The school has consistently attracted outstanding students, as evidenced by the fact that approximately one-third of its students graduate with honors or high honors.

FACILITIES

The offices of the School of Physical and Mathematical Sciences are located in the seven-story Cox Hall, together with the Departments of Physics and Statistics. The adjoining Harrelson Hall, with its 77 classrooms, has as one of its occupants the Department of Mathematics and provides additional classroom space for the school. The new nine-story Dabney Hall, which is adjacent to Cox Hall, houses the Departments of Chemistry and Computer Science. Facilities for geosciences instruction are provided in Withers Hall, a four story structure near the center of the campus. Physics research laboratories are located in Daniels Hall and the Nuclear Science Building and at the Triangle Universities Nuclear Laboratory in Durham. Biochemistry research is underway in Polk Hall and Withers Hall.

The school is fully equipped for instruction and research. Special equipment and laboratories associated with the school include a plasma physics laboratory supported by a research tube-making facility; a complete radio-chemistry laboratory; a one-million volt Van de Graaff accelerator; analog and ambilog computers; an IBM 1130 digital computer; a laser research laboratory; a Varian Associates HA-100 high resolution nuclear magnetic resonance spectrometer; an

upper atmosphere laboratory; a biomathematics and biophysics laboratory; undergraduate and graduate desk computing laboratories; biochemical research and teaching laboratories; and an ultraviolet-infrared-visible spectroscopic laboratory. Other facilities on the campus available for teaching and research are electron microscopes, a heterogeneous nuclear reactor designed for operation at 100 kilowatts, complete x-ray laboratories with diffraction and radiographic equipment, a Beckman Model E analytical ultracentrifuge, precision instrument shops, and an IBM 360 Model 40 digital computer connected by telecommunication lines to the Model 75 at the Triangle Universities Computation Center. North Carolina State University also participates in the Triangle Universities Nuclear Laboratory, which has a 0-35 Mev. cyclo-graaff accelerator.

CURRICULA

The school offers undergraduate programs of study leading to the Bachelor of Science degree, with a major in mathematics, chemistry, computer science, statistics, geology or physics. These curricula have essentially a common freshman year, thereby enabling a student to change, without loss of time, from one department to another in the school during the freshman year. A year of foreign language is required of all students except computer science majors. At least one course each semester must be selected from the offerings of the School of Liberal Arts. These courses serve the dual purpose of developing the student's communication skills and helping him become a responsible citizen.

SHORT COURSES AND INSTITUTES

The School of Physical and Mathematical Sciences offers several short courses and specialized institutes throughout the academic year and during the summer months in chemistry, physics, mathematics, computer science, geology and statistics for high-school teachers and college professors. For more information, write to the dean of the school.

In addition, certain regular courses may be taken for credit through Correspondence or at the Evening College of the Division of Continuing Education in Raleigh, Charlotte or in the Greensboro-Burlington-Winston-Salem area. For a listing of these courses, write to the North Carolina State University Division of Continuing Education at Raleigh.

SUPERIOR STUDENT AND HONOR PROGRAMS

For several years, exceptional students have been selected to participate in the Superior Student Program during their freshman and sophomore years. Enriched courses in mathematics, chemistry, physics and English have been developed specifically for the participants in this program. At the beginning of the junior year, the most promising may select special courses, participate in undergraduate research, and receive some graduate credit toward the Master of Science degree during the senior year.

Well-prepared students entering the school may seek advanced placement in mathematics, chemistry, physics or history by passing qualifying examinations.

STUDENT ACTIVITIES

In addition to the University-wide extracurricular activities and honor organizations, the School of Physical and Mathematical Sciences has student chapters of the following professional and honor organizations: Society of Physics Students; Pi Mu Epsilon; the American Chemical Society; and the Association for the Computing Machinery.

The Science Council, which is composed of elected students from the school, sponsors and participates in a wide variety of technical and social activities.

FRESHMAN YEAR FOR PHYSICAL AND MATHEMATICAL SCIENCES

Fall Semester

	Curriculum and Credits					
	MA	CH	CSC	ST	GY	PY
Basic Science			3			
CH 101 General Chemistry I	4	4		4	4	4
CH 106 Laboratory Techniques I		1				
CSC 101 Intro. to Programming			3	3		
ENG 111 Composition and Rhetoric	3	3	3	3	3	3
Humanities and Social Sciences	3	3			3	3
MA 102 Analytic Geometry and Calculus I	4	4	4	4	4	4
PSM 100 Orientation	0	0	0	0	0	0
Physical Education	1	1	1	1	1	1
	15	16	14	15	15	15

Spring Semester

	Curriculum and Credits					
	MA	CH	CSC	ST	GY	PY
Basic Science			3			
BS 100 General Biology				4		
CH 103 General Chemistry II	4			4		
	or				4	
CH 107 Principles of Chemistry	4	4			4	4
CH 108 Laboratory Techniques II		1				
CSC 111 Algorithmic Languages I	2					
CSC 112 Basic Computer Organization and Assembly Language			3			
ENG 112 Composition and Reading	3	3	3	3	3	3
Humanities and Social Sciences	3					
MA 201 Analytic Geometry and Calculus II	4	4	4	4	4	4
PY 205 General Physics		4			4	4
Physical Education	1	1	1	1	1	1
	17	17	14	16	16	16

GRADUATE STUDY

The Master of Science degree is available with a major in biochemistry, biomathematics, chemistry, geology, statistics, mathematics, applied mathematics and physics. The Master of Applied Mathematics, Master of Biomathematics and Master of Teaching in Mathematics are offered. The Doctor of Philosophy degree is available in biochemistry, biomathematics, chemistry, statistics, mathematics, applied mathematics and physics.

CHEMISTRY

Dabney Hall and Withers Hall

Professor Z Z. HUGUS, JR., Head of the Department

Professor R. H. LOEPPERT, Assistant to the Head of the Department

Associate Professor F. C. HENTZ, JR., Director of General Chemistry

Professors: H. A. BENT, L. H. BOWEN, C. L. BUMGARDNER, G. O. DOAK, L. D. FREEDMAN, S. G. LEVINE, G. G. LONG, W. J. PETERSON, W. A. REID, P. P. SUTTON, R. C. WHITE; Adjunct Professor: M. E. WALL; Professors Emeriti: C. C. ROBINSON, G. H. SATTERFIELD; Associate Professors: H. H. CARMICHAEL, A. F. COOTS, M. K. DEARMOND, F. W. GETZEN, C. E. GLEIT, L. A. JONES, M. L. MILES, C. G. MORELAND, W. P. TUCKER, G. H. WAHL, JR.; Adjunct

Associate Professor: R. W. MORRISON, JR.; *Associate Professor Emeritus:* W. E. JORDAN; *Assistant Professors:* T. J. BLALOCK, J. BORDNER, T. C. CAVES, K. W. HANCK, W. P. INGRAM, JR., A. F. SCHREINER, T. M. WARD, D. W. WERTZ; *Instructors:* W. R. JOHNSTON, ELIZABETH H. MANNING, J. W. MORGAN, G. M. OLIVER, GRAYE J. SHAW, C. WOODS, III; *Teaching and Research Technicians:* MARGARET C. BUNDY, DELORES G. KNIGHT; *Associate Members of the Faculty:* D. M. CATES, H. A. RUTHERFORD (Textile Chemistry)

Chemistry is the science dealing with the composition of all substances and changes in their composition. It is involved with almost every aspect of modern life. Chemists have contributed in large measure to the synthetic fiber industry, petroleum products and fuels, plastics, the food processing industry, nuclear energy, and modern drugs and medicine. Today more than ever a chemist is concerned with the fundamental building blocks of all materials—atoms and molecules. This study is leading to a firmer basis for improving old materials, developing new ones, and controlling the environment in which we live.

OPPORTUNITIES

The chemical industry is the nation's largest manufacturing industry. Chemists comprise by far the largest proportion of scientists in the United States, and every indication is that future demand for chemists will continue to grow. A wider variety of jobs is open to the chemist than any other scientist: from biochemistry to metallurgy, from space science to oceanography, from sales or management to pure research. The B.S. program in chemistry provides an excellent premedical curriculum. Chemists are employed in almost every field based on modern technology. Because of the demand for training in chemistry, opportunities for a chemist in the field of education are many and varied.

UNDERGRADUATE CURRICULUM

A chemist's training must be broad. The undergraduate curriculum, accredited by the American Chemical Society, includes a strong background of mathematics, physics and the liberal arts. The basic areas of organic, physical, inorganic and analytical chemistry are stressed. Laboratory and classroom work develop the skills, knowledge and inquiring spirit necessary for a successful career in chemistry. The minor field and elective credits allow individual diversity at the junior and senior levels. Many undergraduates participate in current research in the department through part-time employment or a senior research project. The curriculum prepares the student for the wide variety of jobs open to the B.S. chemist or for advanced work at the graduate level.

CHEMISTRY CURRICULUM*

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I	4	CH 107 Principles of Chemistry	4
CH 106 Laboratory Techniques I	1	CH 108 Laboratory Techniques II	1
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
MA 102 Analytic Geometry and Calculus I	4	MA 201 Analytic Geometry and Calculus II	4
Social Science	3	PY 205 General Physics	4
Physical Education	1	Physical Education	1
	<hr/> 16		<hr/> 17

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I	4	CH 223 Organic Chemistry II	4
English Elective	3	English Elective	3
MA 202 Analytic Geometry and Calculus III	4	MA 301 Applied Differential Equations I	3
PY 206 General Physics	4	PY 207 General Physics	4
Physical Education	1	Free Electives	3
	<hr/> 16	Physical Education	1
			<hr/> 18

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 428 Qualitative Organic Analysis	3	CH 401 Systematic Inorganic Chemistry	3
CH 431 Physical Chemistry I	3	CH 433 Physical Chemistry II	3
CH 432 Physical Chemistry I Laboratory	1	CH 434 Physical Chemistry II Laboratory	1
Humanities—Social Sciences	3	Humanities—Social Sciences	3
MLG 101 Elementary German I	3	MLG 102 Elementary German II	3
Minor	3	Minor	3
	<hr/> 16		<hr/> 16

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 411 Analytical Chemistry I	4	CH 413 Analytical Chemistry II	4
Chemistry Elective	2	Humanities—Social Sciences	3
Humanities—Social Sciences	3	Minor	3
Minor	3	Free Electives	6
Free Electives	4		<hr/> 16
	<hr/> 16		

* Chemistry majors are required to take CH 101, CH 106, CH 107 and CH 108. The minor may be in any field closely related to chemistry, such as mathematics, physics, computer science, geo-science, statistics, biological sciences, engineering or science education. A total of four courses in two such areas may constitute a "split" minor. The minor field should be chosen in consultation with the faculty adviser prior to or during the junior year.

COMPUTER SCIENCE

Dabney Hall

Professor P. E. LEWIS, *Head of the Department*

Associate Professor: D. A. LINK, *Administrative Assistant*

Professor: L. B. MARTIN, JR.; *Adjunct Associate Professor:* L. H. WILLIAMS;
Assistant Professors: R. J. FORNARO, J. W. HANSON, T. L. HONEYCUTT, L. K.
 McDOWELL, J. D. POWELL, W. A. SILLARS, A. L. THARP, N. F. WILLIAMSON,
 JR.; *Instructors:* D. B. FLANNAGAN, G. G. PHILLIPS, D. W. REID

The discipline of computer science has arisen during the past 25 years as a direct consequence of the rapid growth of the electronic computer. No single technological development in history has had a greater impact on man and on the way he lives. The uses of modern computers are very diverse and new applications continue to arise. They are used to help make and operate our automobiles, airplanes and space ships; to design our highways, bridges and buildings; to handle banking transactions and make management decisions; to analyze farm production; as a research tool for the scientist; to monitor manufacturing processes, utilities and communication; and to provide a multitude of other services. Almost all areas of industry, education and business make use of the computer.

The program of computer science at North Carolina State University is designed to train students to contribute to these applications and if they choose

to continue their training further through graduate study. Methods and techniques are stressed for using the computer in both scientific and business applications. Students may elect to major in the field working toward the degree of Bachelor of Science in computer science. Students in other departments may select as electives certain courses in computer science to broaden their program of study.

In addition to providing a sound background of core courses, the computer science curriculum also provides for more extensive training in several areas or tracks. At the beginning of the junior year, majors in computer science may elect to concentrate study for the last two years of the degree program in one of the following three tracks:

1. Scientific Applications
2. Management Decisions
3. Programming Systems and Languages

Twenty-four credits (called track requirements and restricted electives) may be selected from an approved set of courses appropriate to the track chosen by the student.

There is a need for professionals who are trained in computer science. Salaries are good, and the variety of work is satisfying.

COMPUTER SCIENCE CURRICULUM

For the freshman year see page 205.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CSC 211 Programming Languages	3	CSC 302 Introduction to Numerical Methods	3
Humanities—Social Sciences	3	Humanities—Social Sciences	3
MA 231 Intro. to Linear Algebra	3	English Literature Elective	3
PY 205 General Physics	4	MA 312 Introduction to Differential Equations	3
Free Electives	3	PY 208 General Physics	4
Physical Education	1	Physical Education	1
	—		—
	17		17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CSC 311 Data Structures	3	CSC 312 Computer Organization and Logic	3
CSC 322 Applied Algebraic Structures	3	CSC Track Requirement	3
Humanities—Social Sciences	3	Humanities—Social Sciences	3
ST 371 Introduction to Probability and Statistics	4	Restricted Elective	3
Restricted Elective	3	Free Elective	6
	—		—
	16		18

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CSC 411 Introduction to Simulation	3	CSC 412 Introduction to Computability, Language and Automata	3
CSC Track Requirement	3	Humanities—Social Sciences	3
Humanities—Social Sciences	3	Restricted Electives	6
Restricted Electives	6	Free Elective	3
	—		—
	15		15
			Total Hours—126

GEOSCIENCES

Withers Hall

Professor C. J. LEITH, Head of the Department

Professors: H. S. BROWN, J. LYMAN, J. M. PARKER, III, W. J. SAUCIER; Professor Emeritus: J. L. STUCKEY; Associate Professor: C. W. WELBY; Adjunct Associate Professors: A. V. HARDY, J. R. SMITH; Associate Professor Emeritus: E. L. MILLER, JR.; Assistant Professors: R. J. CARSON, III, V. V. CAVAROC, JR., N. E. HUANG, C. E. KNOWLES, W. H. SPENCE, A. H. WEBER; Adjunct Assistant Professors: W. D. BACH, J. T. PETERSON

The geosciences includes all the overlapping divisions of the physical, chemical and biological earth sciences, such as geology, geophysics, geochemistry, paleontology, meteorology, hydrology and oceanography. The Department of Geosciences offers courses in each of the related disciplines.

Geology is the professional field in which geological knowledge and techniques are focused on the solution of problems concerned with the occurrence, origin and distribution of rock and mineral deposits, raw material supplies and with a variety of engineering projects. Many of the larger engineering undertakings such as the construction of dams and reservoirs, tunnels, big buildings and highways depend for success in part on an exact knowledge of their geological setting. Discovery, evaluation, development and conservation of mineral resources (including fossil fuels and ground water) also require the quantitative and analytical application of the findings of geological science regarding the constitution, structure and history of the earth's crust. The geology curriculum combines training in basic physical and engineering sciences with those aspects of geology that are most pertinent to human affairs.

Meteorology is the science of the atmosphere, including the processes and the phenomena within the atmosphere, the interactions with earth's land and sea surface below, and with the solar atmosphere above. Its objectives are the understanding of the atmosphere and the complex processes occurring within it, and the application of this knowledge to benefit mankind in his welfare and various endeavors. The meteorology courses offered by the Department of Geosciences are designed to provide a basic training for roles in both theory and application, and to prepare the student for either research or the varied professional applications.

One of the challenging fields in geoscience is weather modification and control to enhance water supplies, decrease lightning hazards, protect crops from storm damage and perhaps tame the hurricane and the tornado. The atmosphere has a major influence on radio communication, including rocket guidance and control and missile detection and interception. The problem of atmospheric pollution needs thoughtful and searching attention.

In the past few years the physical and geological characteristics of the oceans have become the subject of major research programs in this and in other countries. The Department of Geosciences offers undergraduate and graduate courses and programs in geological, meteorological and physical oceanography.

The theories, instruments and skills needed and developed to study the earth can now be applied to investigating the moon and planets. Conversely, improvements in instrumentation achieved to further the study of the planets has long been in the domain of astronomy. Now, as instruments reach these other bodies of the solar system, the investigation of them merges into the geosciences.

OPPORTUNITIES

A graduate in geology may follow one of several broad fields either in the United States or in foreign countries: for example, the application of geology

to engineering work; or, the application of geology in the mineral industries. Geologists are currently employed by oil companies and quarrying concerns; exploration companies; construction firms; railroads, public utilities, banks and insurance companies; iron, steel and other metal producers; manufacturers using nonmetallic raw materials, such as ceramics, cement and abrasives; municipal, state and federal government agencies; schools, colleges, museums and research institutes. The southeastern United States offers excellent opportunities. There is a growing need for the application of geological science to engineering construction in connection with highways, foundations, excavations, beach erosion control and water supply problems. The mineral industry of the Southeast has expanded substantially in the last decade; known deposits in the region, as yet only partially developed, include iron, nickel, copper, chromite, molybdenite, feldspar, mica, kaolin, kyanite, sillimanite, pyrophyllite, talc, barite, spodumene, sulphur (pyrite), coal, phosphate, granite, limestone and marl.

GEOSCIENCES CURRICULUM LEADING TO B.S. DEGREE IN GEOLOGY

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chem. I	4	CH 103 General Chem. II	4
ENG 111 Composition & Rhetoric	3	or	
Humanities—Social Sciences	3	CH 107 Prin. of Chem.	
MA 102 Anal. Geom. & Calc. I	4	ENG 112 Composition & Reading	3
PSM 100 Orientation	0	MA 201 Anal. Geom. & Calc. II	4
Physical Education	1	PY 205 General Physics	4
	—	Physical Education	1
	15		16

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
GY 120 Physical Geology	3	English Literature	3
MA 202 Anal. Geom. & Calc. III	4	GY 222 Historical Geology	3
Modern Language	3	GY 330 Crystallography & Min.	3
PY 208 General Physics	4	MA 301 Applied Differential Equations I*	3
Physical Education	1	Modern Language	3
	—	Physical Education	1
	15		16

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 331 Intro. Physical Chemistry**	4	GY 440 Igneous & Meta. Petrology	4
GY 331 Opt. Micr. & X-Ray Diff.	4	GY 452 Exogenic Mat. & Proc.	4
GY 351 Tectonic Structures	3	GY 462 Geological Surveying	3
Humanities—Social Sciences	3	Humanities—Social Sciences	3
Elective	3	Minor***	3
	—		17
	17		17

SUMMER SESSION

GY 465 Geological Field Procedures (or equivalent field camp)	6
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SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
GY 323 Paleontology	3	Geology Elective	3
or		Humanities—Social Sciences	3
GY 415 Min. Expl. & Eval.		Minor***	3
Humanities—Social Sciences	3	Elective	3
Minor***	3		—
Electives	6		12
	15		
Total Hours—129			

* Students electing a minor in statistics may substitute MA 405 for MA 301.

** Students electing a minor in physical sciences (chemistry) will substitute CH 431 for CH 331 and will graduate with a minimum of 129 credit hours.

*** The minor may be in any field closely related to geology, such as engineering science (engineering mechanics, materials engineering), statistics, physical science (chemistry, physics, meteorology), or biological science (botany, genetics, zoology). The minor field should be chosen in consultation with the faculty adviser prior to or during the junior year.

GEOSCIENCES CURRICULUM LEADING TO B.A. DEGREE IN GEOLOGY

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ENG 111 Composition & Rhetoric	3	ENG 112 Composition & Reading	3
HI 101 History of Civilization	3	HI 102 History of Civilization	3
Humanities—Social Sciences*	3	Humanities—Social Sciences*	3
MA 111 Algebra and Trig.	4	MA 112 Anal. Geom. and Calc. A	4
Modern Language (Inter.)	3	Modern Language (Inter.)	3
Physical Education	1	Physical Education	1
	17		17

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I	4	CH 103 General Chemistry II	4
GY 120 Physical Geology	3	GY 222 Historical Geology	3
Humanities—Social Sciences*	3	GY 330 Crystallography and Min.	3
Literature**	3	Humanities—Social Sciences*	3
PHI 205 Prob. & Types of Phi.	3	Literature**	3
Physical Education	1	Physical Education	1
	17		17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
GY 331 Opt. Micros. & X-Ray Diff.	4	GY 440 Igneous & Meta. Petrology	4
HI 422 Rise of Modern Science		GY 452 Exogenic Mat. and Proc.	4
or		PY 212 General Physics	4
PHI 405 Phil. of Science	3	Elective	3
PY 211 General Physics	4		15
Elective	3		
	14		

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
GY 323 Paleontology	3	GY 492 Seminar on Sel. Geol. Top.	3
GY 351 Tectonic Structures	3	Geology Elective	3
Electives	9	Electives	6
	15		12
Total Hours—124			

* EC 205, 206; PS 201, 206, 301, 322; PSY 200, 210; SOC 202, 301; ANT 251, 252. Two of the required four courses must be in departmental sequence.

** ENG 261, 262, 265, 266; ML 301, 302. The literature requirement is a six hour sequence in one literary tradition.

GRADUATE STUDY

The department offers a graduate program leading to the Master of Science degree in geology and through its participation in the interdisciplinary marine sciences program offers work leading to the Master of Science and Doctor of Philosophy degrees in marine sciences with specialization in physical oceanography and meteorological oceanography. Prospective applicants should consult the Graduate School Catalog.

MATHEMATICS

Harrelson Hall

Professor N. J. ROSE, Head of the Department

Professor H. V. PARK, Assistant to the Department Head

Professor H. M. NAHIKIAN, Graduate Administrator

Professors: J. W. BISHIR, R. C. BULLOCK, J. M. A. DANBY, W. J. HARRINGTON, K. KOH, J. LEVINE, P. E. LEWIS, P. A. NICKEL, H. SAGAN, H. E. SPEECE, R. A. STRUBLE, H. R. VAN DER VAART, O. WESLER, L. S. WINTON; *Visiting Professor:* M. ITOH; *Adjunct Professor:* I. N. SNEDDON; *Professors Emeriti:* J. M. CLARKSON, H. A. FISHER, H. P. WILLIAMS; *Associate Professors:* E. E. BURNISTON, R. E. CHANDLER, H. C. COOKE, W. G. DOTSON, JR., R. O. FULP, J. R. KOLB, C. H. LITTLE, JR., J. LUH, J. A. MARLIN, A. R. NOLSTAD, D. M. PETERSON, H. A. PETREA, J. W. QUERRY, G. C. WATSON, J. B. WILSON; *Assistant Professors:* C. N. ANDERSON, V. R. BRANTLEY, T. JOYCE CARAWAY, H. J. CHARLTON, D. E. GAROUTTE, D. J. HANSEN, R. E. HARTWIG, RUTH B. HONEYCUTT, J. E. HUNEYCUTT, JR., C. F. LEWIS, A. MALTBIE, R. H. MARTIN, JR., L. K. McDOWELL, C. D. MEYER, JR., L. B. PAGE, C. V. PAO, R. T. RAMSAY, R. G. SAVAGE, R. SILBER, J. L. SOX, JR., G. S. SPEIDEL, JR., E. L. STITZINGER, D. F. ULLRICH; *Visiting Assistant Professor:* R. GELLAR; *Assistant Professors Emeriti:* R. A. MACKERRACHER, P. SHAHDAN; *Instructors:* DOROTHY L. BRANT, H. L. CROUCH, JR., H. L. DAVISON, T. F. GORDON, G. F. KNIGHT, D. W. KRIDER, CARLOTTA P. PATTON

Mathematics has long played an important role in the intellectual and technological history of mankind. However, in recent years, there has been a truly dramatic expansion of the knowledge and applications of mathematics. There is consequently a large demand for people who are well versed in pure or applied mathematics.

CURRICULUM

The undergraduate major in mathematics provides a core of basic courses in mathematics together with a program of electives that is sufficiently flexible to prepare a student for graduate study in pure or applied mathematics, for careers in industry, business or government, or for teaching. A carefully selected set of required courses and electives in science, humanities and modern language provide a total program that is well adapted to the demands of modern day life.

MATHEMATICS CURRICULUM

For the freshman year see page 205.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
English Literature	3	MA 232 Introduction to Multivariable Calculus	3
Humanities Elective*	3	MA 312 Introduction to Differential Equations	3
MA 231 Introduction to Linear Algebra	3	Modern Language	3
Modern Language	3	PY 208 General Physics	4
PY 205 General Physics	4	Free Elective	3
Physical Education	1	Physical Education	1
	17		17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanities Elective*	3	Humanities Elective*	3
MA 403 Introduction to Modern Algebra	3	MA 426 Mathematical Analysis II	3
MA 425 Mathematical Analysis I	3	Mathematics Elective***	3
Restrictive Elective**	3	Restricted Electives***	6
Free Elective	3		15
	15		

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanities Elective*	3	Humanities Elective*	3
Math Elective***	3	Math Electives***	6
MA 421 Introduction to Probability	3	Restricted Elective**	3
or		Free Elective	3
ST 421 Introduction to Mathematical Statistics			15
Restricted Elective**	3	Total Hours—126	
Free Elective	3		
	15		

* Humanities or Social Science. Six hours must be at junior-senior level.

** Restricted electives are subject to departmental approval and are expected to be in fields such as physical science, life science, engineering, selected courses in economics, psychology, etc.

*** Mathematics electives are chosen from approved 400-500 courses. These should be chosen to fulfill a career objective.

GRADUATE STUDY

Graduate programs are offered at both the masters and doctoral levels. The core of basic courses in algebra, analysis and topology are required of all students. The remaining program is quite flexible. The large variety of course offerings in the department in conjunction with the many other scientific and engineering departments allow for any desired degree of emphasis in either pure or applied mathematics.

PHYSICS

Professor L. W. SEAGONDOLLAR, Head of the Department

Professor J. T. LYNN, Assistant to the Head of the Department

Visiting University Professor: L. H. THOMAS; Professors: W. H. BENNETT, J. M. A. DANBY, W. R. DAVIS, W. O. DOGETT, G. L. HALL, A. W. JENKINS, JR., H. C. KELLY, E. R. MANRING, J. D. MEMORY, A. C. MENIUS, JR., R. L. MURRAY, D. L. RIDGEWAY, A. W. WALTNER; Professors Emeriti: F. W. LANCASTER, J. S. MEARES, R. H. SNYDER; Associate Professors: G. C. COBB,

JR., F. G. EVERLING, G. H. KATZIN, D. H. MARTIN, G. E. MITCHELL, M. K. MOSS, J. Y. PARK, R. R. PATTY, D. R. TILLEY; *Assistant Professors*: K. T. CHUNG, R. E. FORNES, F. LADO, JR., G. W. PARKER, III, J. F. SCHETZINA; *Assistant Professor Emeritus*: E. J. BROWN; *Instructors*: JANICE M. BIRELINE, W. B. BOWMAN, II, H. L. OWEN; *Instructor Emeritus*: MINNIE W. C. HARRIS

Physics is a fundamental science of observations, measurements and the mathematical description of the particles and processes of nature. In addition to extending our basic knowledge of the universe, the science of physics provides the means for attacking problems of importance in modern technology. The variety of the contributions made by physicists is indicated by such typical recent activities as the discovery of new particles of nature, the invention and use of new instruments to probe interplanetary space, the study of processes fundamental to the release of thermonuclear energy, the development of lasers and solid state devices and research on missiles, satellites and space craft.

PROGRAMS

The physics department provides at both the graduate and undergraduate levels programs of study in fundamental physics and in several areas of specialization, including relativity theory, nuclear physics, plasma physics, infrared spectroscopy, magnetic resonance, atmospheric physics, solid state physics and lasers.

UNDERGRADUATE STUDY

The undergraduate curriculum in physics provides the basic training for a career in physics or for graduate study.

PHYSICS CURRICULUM

For the freshman year see page 205.

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
English Elective	3	Humanities—Social Sciences	3
Humanities—Social Sciences	3	MA 301 Applied Dif. Equa. I	3
MA 202 Anal. Geo. & Calc. III	4	Modern Language	3
Modern Language	3	PY 207 General Physics	4
PY 206 General Physics	4	PY 413 Thermal Physics	3
Physical Education	1	Physical Education	1
	18		17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
MA 511 Advanced Calculus I	3	Humanities—Social Sciences	3
PY 411 Mechanics I	3	Mathematics Elective	3
PY 414 Elec. & Mag. I	3	PY 412 Mechanics II	3
PY 451 Intermed. Exps. in Phys. I	2	PY 415 Elec. & Mag. II	3
Free Elective	3	PY 452 Intermed. Exps. in Physics II	2
	14	Free Elective	3
			17

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanities—Social Sciences	3	Humanities—Social Sciences	3
Mathematics Elective	3	PY 402 Modern & Quan. Physics II	3
PY 401 Mod. & Quan. Physics I	3	PY 409 Ion & Electron Physics	3
PY 410 Nuclear Physics I	4	PY 416 Physical Optics	3
Free Elective	3	Free Elective	3
	16		15
			Total Hours—128

GRADUATE STUDY

The Department of Physics offers the Master of Science and Doctor of Philosophy degrees. Prospective applicants should consult the Graduate School Catalog.

STATISTICS

Cox Hall

Professor D. D. MASON, Head of the Department

Professor R. G. D. STEEL, Graduate Administrator

Professor F. E. MCVAY, Undergraduate Administrator

Professors: C. C. COCKERHAM, A. H. E. GRANDAGE, R. J. HADER, D. W. HAYNE, H. L. LUCAS, JR., R. J. MONROE, C. H. PROCTOR, C. P. QUESENBERRY, J. O. RAWLINGS, D. L. RIDGEWAY, J. A. RIGNEY, H. R. VAN DER VAART, T. D. WALLACE, O. WESLER; *Adjunct Professors:* A. L. FINKNER, D. G. HORVITZ, J. T. WAKELEY; *Professor Emeritus:* GERTRUDE M. COX; *Associate Professors:* B. B. BHATTACHARYYA, H. J. GOLD, M. M. GOODMAN, W. L. HAFLEY, L. J. HERBST, C. H. LITTLE, A. R. MANSON, L. A. NELSON, J. A. WARREN; *Adjunct Associate Professor:* D. W. GAYLOR; *Assistant Professors:* T. M. GERIG, A. C. LINNERRUD, D. C. MARTIN, B. F. SWINDEL (USFS), J. L. WASIK, MARY B. WILLIAMS; *Adjunct Assistant Professors:* D. L. BAYLESS, H. T. SCHREUDER; *Instructor:* JOLAYNE W. SERVICE; *Senior Research Technologist:* F. J. VERLINDEN; *Research Associate Technologist:* A. J. BARR; *Research Assistant Technologist:* J. L. CHRISTOPHER; *Research Associates:* A. ANGELONE, R. P. GECKLER, J. GRAHAM; *Associate Statisticians:* H. K. HAMANN, R. E. MASON, B. J. STINES; *Assistant Statisticians:* J. H. GOODNIGHT, H. J. KIRK, BARBARA D. SMITH, D. W. TURNER, F. T. WANG, PHYLLIS A. WEBB

Statistics is the body of scientific methodology which deals with the logic of experiment and survey design, the efficient collection and presentation of quantitative information, and the formulation of valid and reliable inferences from sample data.

The Department of Statistics at Raleigh is part of the Institute of Statistics, which also includes a Department of Biostatistics and a Department of Statistics at Chapel Hill. The Department of Statistics provides instruction, consultation and computational services on research projects for other departments of all schools at North Carolina State University including the Agricultural Experiment Station; the department staff are also engaged in an extensive program of research in statistical theory and methodology. This wide range of activities furnishes an excellent professional environment for training students in the use of statistical procedures in such fields as the physical, biological and social sciences, and in industrial research, development and engineering.

OPPORTUNITIES

The graduate in statistics will find abundant employment opportunities that will be intellectually and financially rewarding. The importance of sound statistical thinking in the design and analysis of quantitative studies is generally recognized. Industry relies on statistical methods to control the quality of goods in the process of manufacture and to determine the acceptability of goods produced. Statistical procedures based on scientific sampling have become basic tools in such diverse fields as weather forecasting, opinion polling, crop and

livestock estimation, and business trend prediction. Because he can improve the efficiency of use of increasingly complex and expensive experimental and survey data, the statistician will continue to be in demand wherever quantitative studies are conducted.

TYPICAL STATISTICS CURRICULUM

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I	4	BS 100 General Biology	4
CSC 101 Introduction to Programming	3	CH 103 General Chemistry II	4
ENG 111 Composition and Rhetoric	3	ENG 112 Composition and Reading	3
MA 102 Analytic Geometry and Calculus I	4	MA 201 Analytic Geometry and Calculus II	4
PSM 100 Orientation	0	Physical Education	1
Physical Education	1		16
	15		

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
EC 205 Economic Activity	3	EC 206 The Price System	3
MA 231 Intro. to Linear Algebra	3	MA 232 Intro. to Multivariable Calculus	3
PY 205 General Physics	4	PSY 200 Introduction to Psychology	3
ST 371 Introduction to Probability and Statistics	4	PY 208 General Physics	4
Physical Education	1	Major Elective	3
	15	Physical Education	1
			17

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Biological Science Elective	3	Humanities Elective	3
Humanities Elective	3	Modern Language	3
Modern Language	3	Major Elective	3
ST 421 Introduction to Mathematical Statistics	3	ST 422 Introduction to Mathematical Statistics	3
Major Elective	3	Free Elective	3
Free Elective	3		15
	18		

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
ENG 321 Communication of Technical Information	3	Humanities Elective	3
Humanities Elective	3	SP 231 Expository Speaking	3
ST 501 Basic Statistical Analysis	3	ST 502 Basic Statistical Analysis	3
Major Elective	3	Major Elective	3
Free Elective	3	Free Elective	3
	15		15

Total Hours—126

GRADUATE STUDY

The Department of Statistics offers work leading to the Master of Science, Master of Statistics (nonthesis) and Doctor of Philosophy degrees. Prospective applicants should consult the Graduate School Catalog.

TEXTILES

Nelson Textile Building

DAVID W. CHANEY, *Dean*

W. E. SMITH, *Assistant to the Dean for Student Affairs*

JAMES W. KLIBBE, *Academic Coordinator*

MALCOM E. CAMPBELL, *Dean Emeritus*

The manufacture of textiles is one of the world's leading industries. North Carolina's textile industry now ranks among the first in the nation in terms of employment and value of manufactured products. Furthermore, the textile industry of the State and the area is broadly diversified, ranging from production of man-made fibers to finished garments, from cotton spinning mills to finishing plants, from woven goods to all types of knitted materials, and from suppliers to machine manufacturers.

In the past few years rapid technological and marketing changes have been taking place in the textile industry, placing a higher demand upon academic training, both specialized and industry-wide. Opportunities have been created for the application of the latest developments in science and technology, computer science, marketing, merchandising, economics, business management, the creative and technical aspects of style and design, and new product development.

In response to these revolutionary changes, the School of Textiles has greatly increased the scope of its educational program to offer opportunities for challenging careers in the modern textile industry. The purpose of the school is to educate men and women for professional activity in all phases of the textile industry and in so doing to develop their capacities for intelligent leadership.

In the educational program, for administration, the School of Textiles is organized into two departments: textile technology and textile chemistry.

CURRICULA

The School of Textiles offers a broad choice of curricula depending upon the interests of the individual student. Terminal B.S. programs in textile technology or in textile chemistry permit the broadest choice of courses in addition to the core courses that are required. For example a student may specialize in yarn or fabric structures, in textile economics and marketing, or fabric styling and design. The student's curriculum will include choices in the humanities, social sciences and basic sciences and, according to the emphasis he chooses, may result in a minor in economics, industrial engineering, languages, mathematics, physics, political science, statistics or textile chemistry (or technology). The structure of the minor sequence of courses may be such that a student can proceed to graduate study in either the minor field or in textile chemistry or technology. Alternatively it is possible, with only one summer of extra work, to obtain a double degree, for example in textile technology and textile chemistry.

Curricula leading to graduate study, particularly to Ph.D. programs such as that offered by the School of Textiles in fiber and polymer science, differ from those of terminal B.S. programs primarily in the junior and senior year. While considerable latitude is still possible, there are a number of prescribed courses that must be taken. The nature of these will depend upon the type of graduate study anticipated.

Textile chemistry is designed to give the student a fundamental education in chemistry with special emphasis on the application of this science to textiles. The textile chemistry curriculum places emphasis on chemical fundamentals so that those students who complete this program with a high degree of excellence are adequately prepared for graduate study either in pure or applied chemistry. Similarly, students who complete the program in any one of the minors in textile technology with a high degree of excellence would be acceptable for graduate study in many different areas.

Inasmuch as the professional work in textiles is concentrated to a great extent in the last two years of the student's program, it is quite possible for students from either junior or community colleges or other institutions of higher learning to transfer to the School of Textiles with a minimum loss of time.

INSPECTION TRIPS

For certain of the textile courses offered, it is desirable for the student to see the manufacturing process under actual operating conditions. When possible, trips are arranged for student groups to visit outstanding manufacturing plants. Participation in the trips is required; transportation costs and other travel expenses, while held to a minimum insofar as possible must be paid by the student.

DEGREES

Upon completion of programs in either textile technology or textile chemistry, the degree of Bachelor of Science is conferred.

The School of Textiles offers the following degrees: Bachelor of Science in textile technology or textile chemistry; Master of Textile Technology; Master of Science in textile technology or textile chemistry; and Doctor of Philosophy in fiber and polymer science. For general requirements for graduate degrees, consult the Graduate School Catalog.

By mutual agreement between the faculties involved, candidates for the Doctor of Philosophy degree in other schools of this institution may specialize in essentially textile related subjects. In such cases, it is often logical for the research involved to be done in the School of Textiles.

THE FOUR-ONE PROGRAM

The School of Textiles has developed a program designed to permit the student with a baccalaureate degree from an accredited college or university to complete the requirements for a B.S. degree in textile technology or textile chemistry after the satisfactory completion of one year of study.

Students entering this program should have completed mathematics, physics and chemistry comparable to that required in the basic textile technology or textile chemistry curriculum. Presuming that these conditions are met, the student can complete the degree requirements in two regular semesters and summer school. Students not meeting the minimum requirements in the sciences or applied mathematics could remove these deficiencies in the summer session prior to the fall semester, which would mean that completion of studies would be achieved at the end of the normal period or in the following summer sessions.

The undergraduate program of each applicant is considered individually and, in general, a complete transfer of credits is possible.

FACILITIES

The Nelson Textile Building, erected in 1939 and greatly enlarged in 1950, was designed to coordinate teaching and laboratory facilities. It houses one of

the most modern and best-equipped textile institutions in the world. The Department of Textile Chemistry is housed in the Clark Laboratories, located south of the Nelson Textile Building.

OPPORTUNITIES

Technological advances in textile fibers and manufacturing techniques have created a tremendous demand for men educated in textile colleges. For the past several years, the School of Textiles has had a demand for graduates far greater than it could supply. Its graduates have entered the textile industry at salaries equal to or better than those offered in any other industry.

Graduates of the school are equipped to enter the many expanding activities of the textile field; and alumni of the school hold responsible positions in the general areas of manufacturing, marketing, research and administration. Many are now plant managers, presidents and other top-level executives.

To assist in the placement of students and alumni and to facilitate interviews by textile firms, the school maintains a fulltime director of student affairs and placement.

TEXTILE CHEMISTRY

David Clark Laboratories

Professor H. A. RUTHERFORD, Head of the Department

Professor D. M. CATES, Graduate Administrator

Professors: K. S. CAMPBELL, R. D. GILBERT, G. GOLDFINGER; Adjunct Professors: A. E. DAVIS, JR., H. F. MARK, A. M. SOOKNE; Associate Professors: J. A. CUCULO, T. H. GUION, A. C. HAYES, L. L. HEFFNER (USDA), R. MCGREGOR; Assistant Professors: M. H. THEIL, W. K. WALSH; Adjunct Assistant Professors: K. K. GROSH, W. R. MARTIN, JR.; Instructor: C. D. LIVENGOOD; Research Associate: C. E. BRYAN; Research Assistant: ROSA D. KIRBY

The field of textile chemistry embraces a number of disciplines and is concerned, in part, with those industrial processes that constitute the final steps in the preparation of textile materials for the consumer. Common terms applied to these processes are scouring, bleaching, printing, dyeing and finishing. Textile chemistry is also concerned with fiber-forming polymers, both natural and man-made, and how the chemical and physical properties of such materials vary with fiber structure. The purpose of the department is to provide students with a fundamental knowledge of the underlying principles that relate to this derivative field, and a perspective that includes the many interacting factors involved in the preparation and conversion of polymeric materials to useful products.

CURRICULA

The department has two curricula, referred to below as Programs "A" and "B". "A" is specifically designed for those students who wish to take an advanced degree in Fiber and Polymer Science. "B" is oriented toward a terminal B.S. degree. However, pursual of "B" by the undergraduate does not mitigate against the student's entering a graduate program; by proper choice of electives beginning in the junior year a student may terminate program "B" with essentially the same background as one who takes "A" from the start.

The essential difference between the two is that "A" requires more mathematics, chemistry and textile chemistry than "B". The course sequences required

are described in footnotes under each program.

Although not indicated specifically in the curricula outlines below, the student may choose a minor in a number of different disciplines. Choice of course material is flexible and is made in consultation with the student's adviser. Moreover, through the proper choice of electives a student may, in a four-year period, complete the requirements for two degrees: textile chemistry and textile technology; textile chemistry and chemistry; and textile chemistry and mathematics. Other combinations are possible, but may require a fifth year of study.

FACILITIES

Located in the David Clark Laboratories are departmental offices, classrooms, laboratories and pilot facilities for instruction and research. The departmental radiation laboratory is located in the Nelson Building.

Equipment is available for ultra-violet, visible, infrared, nmr and esr spectroscopy, reflectometry, colorimetry, viscometry, chromatography, differential thermal analysis, thermal gravimetric analysis, differential scanning calorimetry, instrumental measurement of color and computer color matching. Common testing equipment used for the evaluation of the physical properties of textile materials and for determining the color-fastness, wash-fastness, etc., of fibers and fabrics is also available. Complete pilot plant facilities are available for demonstration of all wet-processing operations used in the field of textiles.

TEXTILE CHEMISTRY CURRICULUM

Program A

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I	4	CH 107 Princ. of Chemistry	4
ENG 111 Comp. and Rhetoric	3	ENG 112 Comp. and Reading	3
MA 112 Anal. Geom. & Calc. A*	4	MA 212 Anal. Geom. & Calc. B.	3
or		or	
MA 102 Anal. Geom. & Calc. I	4	MA 201 Anal. Geom. & Calc. II	4
T 101 Fund. of Textiles	2	TX 250 Fabric Forming Systems	4
TX 220 Yarn Forming Systems	4	Physical Education	1
Physical Education	1		
	<hr/> 18		<hr/> 15 or 16

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I	4	CH 223 Organic Chemistry II	4
Humanity or Social Science**	3	Humanity or Social Science	3
Humanity (English)	3	MA 301 Applied Diff. Equa. I	3
MA 114 Topics in Modern Math.	3	PY 211 General Physics**	4
or		or	
MA 202 Anal. Geom. & Calc. III	4	PY 205 General Physics	4
Physical Education	1	ST 361H Intro. to Stat. for Engrs. I	3
	<hr/> 15 or 16	Physical Education	1
			<hr/> 18

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 315 Quantitative Analysis	4	CH 431 Physical Chemistry I	3
PY 212 General Physics	4	Humanity (English)	3
or		Humanity or Social Science	3
PY 208 General Physics	4	TC 303 Textile Chemistry III	4
TC 461 (CH 461) Chem. of Fibers	3	TC 412 Tex. Chem. Analysis II	3
TX 330 Tex. Meas. & Qual. Control	4		
	<hr/> 15		<hr/> 16

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 433 Physical Chemistry II	3	TC 404 Textile Chemical Tech.	3
Humanity or Social Science	3	TC 406 Tex. Chem. Tech. Lab.	2
TC 403 Textile Chemical Tech.	3	TC 491 Seminar in Tex. Chem.	1
TC 405 Tex. Chem. Tech. Lab.	2	Textile Chemistry Elective****	3
Textile Chemistry Elective****	3	Free Elective	6
Free Elective	3		15
	17		Total Hours—128-131

* One of the following mathematics sequences is required: MA 114, MA 112, and MA 212 or MA 102, MA 201 and MA 202.

** One of the following physics sequences is required: PY 211 and PY 212 or PY 205 and PY 208.

*** The Humanity and Social Science electives must form a sequence of related courses and meet the approval of the student's adviser. Humanities means fine arts, history, literature, languages, philosophy and religion. Social Science means anthropology, economics, political science, psychology and sociology.

**** Textile chemistry electives are:

TC 400 The Science of Color

Prerequisite: Junior standing

TC 505 Theory of Dyeing

Prerequisite: CH 433

TC 561 Organic Chemistry of High Polymers

Prerequisite: TC 461 or CH 331 or CH 431

TC 562 (CH 562) Physical Chemistry of High Polymers—Bulk Properties

Prerequisite: CH 220 or CH 223, CH 331, CH 431

TEXTILE CHEMISTRY CURRICULUM

Program B

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I	4	CH 107 Princ. of Chemistry	4
ENG 111 Comp. and Rhetoric	3	ENG 112 Comp. and Reading	3
MA 112 Anal. Geom. & Calc. A*	4	MA 212 Anal. Geom. & Calc. B	3
or		or	
MA 102 Anal. Geom. & Calc. I	4	MA 201 Anal. Geom. & Calc. II	4
TX 101 Fund. of Textiles	2	TX 250 Fabric Forming Systems	4
TX 220 Yarn Forming Systems	4	Physical Education	1
Physical Education	1		15 or 16
	18		

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 221 Organic Chemistry I	4	CH 223 Organic Chemistry II	4
Humanity or Social Science**	4	Humanity or Social Science	3
Humanity (English)	3	PY 211 General Physics**	4
MA 114 Topics in Modern Math.	3	or	
or		PY 205 General Physics	4
MA 202 Anal. Geom. & Calc. III	4	ST 361H Intro. to Stat. for Engrs. I	3
Physical Education	1	Free Elective	3
	15 or 16	Physical Education	1
			18

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 315 Quantitative Analysis	4	Humanity (English)	3
PY 212 General Physics	4	Humanity or Social Science	3
or		TC 303 Textile Chemistry III	4
PY 208 General Physics	4	TC 412 Tex. Chem. Analysis II	3
TC 461 (CH 461) Chem. of Fibers	3	Elective from Schedule A	4
TX 330 Tex. Meas. & Qual. Control	4		17
	15		

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
TC 403 Textile Chem. Tech.	3	Humanity or Social Science	3
TC 405 Tex. Chem. Tech. Lab.	2	or	
Textile Chemistry Elective****	3	Textile Chemistry Elective****	3
Elective from Schedule A	3	TC 404 Textile Chem. Tech.	3
Humanity or Social Science	3	TC 406 Tex. Chem. Tech. Lab.	2
Free Elective	3	TC 491 Seminar in Tex. Chem.	1
	17	Textile Chemistry Elective****	3
		Free Elective	3

15
Total Hours—129-131

Schedule A—Schedule A comprises a two-course sequence totaling six semester hours. The sequence elected by the student must meet the approval of his adviser. One of the following sequences must be elected:

PY 411 Mechanics I	3	CH 431 Physical Chemistry I	3
PY 412 Mechanics II	3	CH 433 Physical Chemistry II	3
	6		6
MA 511 Adv. Calc. I	3	TX 431 Special Topics in Testing	3
MA 512 Adv. Calc. II	3	TX 530 Textile Quality Control	3
	6		6

CH 331 Introductory Physical Chemistry .. 4
and choice of:
MA 301 Applied Differential Equations I .. 3
CHE 541 Cellulose Industries 3 |

CHE 543 Technology of Plastics 3 |

CH 441 Colloid Chemistry 3 |

CHE 501 Applications of Structure—

Property Relationships of Chemical

Engineering Materials 3 |

7

* One of the following mathematics sequences is required: MA 114, MA 112 and MA 212 or MA 102, MA 201, and MA 202.

** One of the following physics sequences is required: PY 211 and PY 212, or PY 205 and PY 208.

*** The Humanity and Social Science electives must form a sequence of related courses and meet the approval of the student's adviser. Humanities means fine arts, history, literature, languages, philosophy and religion. Social Science means anthropology, economics, political science, psychology and sociology.

**** Textile chemistry electives are:

TC 400 The Science of Color

Prerequisite: Junior standing

TC 505 Theory of Dyeing

Prerequisite: CH 433

TC 561 Organic Chemistry of High Polymers

Prerequisite: TC 461, CH 331 or CH 431

TC 562 (CH 562) Physical Chemistry of High Polymers—Bulk Properties

Prerequisite: CH 220 or CH 223, CH 331, CH 431

GRADUATE STUDY

The Department of Textile Chemistry offers a master's degree in textile chemistry. Prospective applicants should consult the Graduate School Catalog.

TEXTILE TECHNOLOGY

Nelson Textile Building

Professor J. F. BOGDAN, Acting Head of the Department

Professors: D. S. HAMBY, S. P. HERSH, J. A. PORTER, JR.; *Professors Emeriti:* E. B. GROVER, J. T. HILTON, W. E. SHINN; *Associate Professors:* A. H. M. EL-SHIEKH, T. W. GEORGE, J. W. KLIBBE, P. R. LORD, W. E. MOSER, J. E. PARDUE, T. G. ROCHOW, W. C. STUCKEY, JR.; *Research Associate Professor:*

E. H. BRADFORD; *Assistant Professors*: P. BROWN, W. D. COOPER, R. E. FORNES, B. S. GUPTA, W. K. LYNCH*, H. M. MIDDLETON, JR., D. M. POWELL; *Research Assistant Professor*: E. E. HUTCHISON; *Instructors*: P. L. GRADY, FRANCES W. MASSEY, M. L. ROBINSON, JR., G. W. SMITH, P. A. TUCKER, JR.; *Visiting Lecturer*: M. H. M. MOHAMED; *Consulting Scientist*: ROBERT PEEL

The purpose of the textile technology department is to instruct students in the theory and fundamental concepts of fiber properties and fiber processing into yarns and fabrics. This is accomplished through the systematic study of the basic properties of both the materials being processed and of the process involved in manufacturing. In addition, the department is engaged in research, with the support for certain work coming from University funds, and contract research through the industrial and governmental sponsors. Not only faculty, but graduate and, when practical, undergraduate students are encouraged to participate in the research programs.

CURRICULUM

The curriculum, during the student's first two years, is concerned primarily with the physical sciences, humanities and social sciences, with limited but very important basic studies in textile fundamentals. Following this phase of work, the student in his junior and senior year does his major work in textiles.

The primary objective of the textile technology curriculum is to provide as general an education as possible and at the same time to prepare the graduate for a profitable and rewarding career in the textile industry. This is accomplished through an integration of the physical and social sciences and the application of these sciences and economics to the field of textiles.

In addition to the wide selection of sciences, the student also has the opportunity for diversification within the School of Textiles. The curriculum offers depth in such selected areas as fiber and yarn technology, fabric technology, knitting technology, general textiles and textile economics and marketing.

MINORS

For a student to develop a second field of interest, the Department of Textile Technology offers, in addition to the major field of study, an opportunity for the student to select a minor from a discipline outside the department. The student may, however, select to do most of his work in textile technology.

These minors add two facets to the student's possible growth. Not only can strength be developed in a second discipline, but upon completion of the undergraduate work, a student may pursue a graduate program of study in textiles or in the discipline selected as the minor.

Selection of the minor field of study can, in most cases, be delayed until the first semester of the junior year. This permits the student time to determine which minor subject holds the greatest interest. This timing is also appropriate for the transfer student on the University campus and from other schools such as the community colleges since most or all of the work in the other school can be applied to the requirements of the first two years of study in the department. If the transfer student has completed two full years at another institution, the amount of prerequisite work is minimized since the majority of the major and minor studies are concentrated in the junior and senior years.

FACILITIES

The facilities of the Department of Textile Technology are subdivided into laboratory areas for processing of cotton and other short staple fibers; woolen,

* On leave.

worsted and long staple synthetic fibers, throwing and texturizing continuous filament yarns. Too, laboratories for the study of the formation of woven, knitted and nonwoven fabrics including tufting and yarn preparation systems are available. The knitting laboratories include a hosiery section, circular and double knitting, warp and flat knitting, and knit goods finishing. The department has extensive facilities for physical testing of fibers, yarns and fabrics. A textile physics laboratory includes equipment designed for specialized problems related to textiles.

TEXTILE TECHNOLOGY CURRICULUM

FRESHMAN YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CH 101 General Chemistry I	4	CH 103 General Chemistry II	4
ENG 111 Comp. & Rhetoric	3	or	
Hum.—Social Sci. Elective	3	CH 107 Princ. of Chemistry	3
MA 111 Algebra & Trig.*	4	ENG 112 Comp. & Reading	4
T 101 Fundam. of Textiles	2	MA 112 Anal. Geo. & Cal. A	4
Physical Education	1	TX 220 Yarn Form. Systems	4
	<u>17</u>	Physical Education	1
			<u>16</u>

SOPHOMORE YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
CSC 111 Algorithmic Lang. I	2	Hum.—Soc. Sci. Elective	3
Hum.—Soc. Sci. Elective	3	PY 211 General Physics	4
MA 212 Anal. Geo. & Calc. B	3	TX 211 Fiber Science II	3
TC 203 Fiber Science I	3	TX 320 Des. & Con. of Staple Yn. Sys.	5
TX 250 Fab. Form. Systems	4	Physical Education	1
Physical Education	1		<u>16</u>
	<u>16</u>		

JUNIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
PY 212 General Physics	4	TX 350 Wov. Fab. Struc.	5
ST 361H Intro. to Stat. for Engrs. I	3	TX 380 Man. & Con. of Tx. Sy.	3
TC 301 Tech. of Dyeing & Finishing	5	TX 460 Phys. Prop. of Tex. Fibers	3
TX 340 Prin. of Knit. Fab. Struc.	5	or	
	<u>17</u>	TX 560 Struc. & Phy. Prop. of Fib.	3
		Option Hours (Prog. A, B, C)	3
		Free Elective	3
			<u>17</u>

SENIOR YEAR

<i>Fall Semester</i>	<i>Credits</i>	<i>Spring Semester</i>	<i>Credits</i>
Humanity—Soc. Sci. Elec.	3	Humanity—Soc. Sci. Elec.	6
TX 330 Tx. Mea. & Qual. Con.	4	Option Hours (Prog. A, B, C)	6
Option Hours (Prog. A, B, C)	6	Free Elective	3
Free Elective	3		<u>15</u>
	<u>16</u>		

Total Hours—130

PROGRAM A

Program A is designed for the student interested in pursuing advanced studies in the basic and applied sciences. The textile courses in the option emphasize the physics and mechanics of textile structures and materials. The program is ideally suited for but not limited to those interested in pursuing graduate studies in the M.S. or Ph.D. programs. The actual sequence of courses constituting the 15 hours in the option would be selected based upon the interest of the student with the approval of the faculty adviser. Typical courses from which the option may be structured are: MA 301, MA 511, EM 301, PY 411, PY 412, PY 413, TC 461, TX 465, TX 490, TX 500, TX 561. The student would be expected to select at least six hours of 400 or 500 level textile courses.

PROGRAM B

Program B, consisting of 15 hours, is based upon a background in basic economics and is designed to develop an understanding of management control systems, decision-making theories and marketing, and distribution systems. Six hours of course work must be selected from EC 312, EC 411, EC 420, EC 425, MA 405, ST 421. Required courses in the option are TX 480, TX 482 and TX 484.

PROGRAM C

Program C provides an opportunity for students to elect advanced courses of study in the field of textiles. These courses may be selected from the elective offerings by the department and may be used to develop in-depth study in knitting, yarn forming systems, fabric forming systems, quality control or combinations of these areas.

For those students interested in developing a sequence of courses in a discipline outside of the Department of Textile Technology, these 15 hours may be used in whole or in part for courses in computer science, mathematics, physics, industrial engineering, textile chemistry and statistics. The sequence of courses comprising the program of study will be planned by the student and faculty adviser.

Those textile technology students interested in a sequence of courses in textile chemistry are encouraged to develop a program that will lead to a dual degree in textile technology and textile chemistry.

Eighteen credit hours of humanity-social science electives are required. These 18 hours are to include three credit hours each of political science, English and EC 206. When practical, students are to be encouraged to take a minimum of two courses in areas chosen to fulfill the humanity-social science requirement. The choice of course sequence and scheduling will be planned by the faculty adviser and the student.

TYPICAL PROGRAM OF STUDY FOR THE FOUR-ONE BACHELOR OF SCIENCE CURRICULUM IN TEXTILE CHEMISTRY AND TEXTILE TECHNOLOGY

TEXTILE CHEMISTRY

TEXTILE TECHNOLOGY

SUMMER SEMESTER

First Session

<i>Credits</i>	<i>Credits</i>
ST 361 Intro. to Statistics for Engineers I** 3	TC 203 Fiber Science I 3
TX 220 Yarn Form. Systems 4	TX 220 Yarn Form. Systems 4
<hr/> 7	<hr/> 7

Second Session

<i>Credits</i>	<i>Credits</i>
TX 250 Fab. Form. Systems 4	TX 211 Fiber Science II 3
<hr/> 4	TX 250 Fab. Form. Systems 4
	<hr/> 7

* MA 114 may, under certain circumstances, be substituted for MA 111. For students qualifying the math sequence shall be MA 102, Analytic Geometry and Calculus I, MA 201, Analytic Geometry and Calculus II, MA 202, Analytic Geometry and Calculus III.

Fall Semester

	<i>Credits</i>		<i>Credits</i>
TC 403 Tex. Chem. Tech.	3	ST 361 Intro. to Statistics for	
TC 405 Tex. Chem. Tech. Lab.	2	Engineers I**	3
TC 461 (CH 461) Chem. of Fibers	3	TX 320 Design & Con. of Staple	
Textile Chem. Elective*	3	Yn. Systems	5
TX 330 Tx. Mea. & Qua. Con.	4	TX 340 Prin. of Knitted	
	15	Fabric Structures	5
		TX 350 Wov. Fab. Structures	5
			18

Spring Semester

	<i>Credits</i>		<i>Credits</i>
CH 331 Intro. Phys. Chem.	4	TC 301 Tech. of Dye. & Fin.	5
TC 404 Tex. Chem. Tech.	3	TX 330 Tx. Mea. & Qual. Con.	4
TC 406 Tex. Chem. Tech. Lab.	2	TX 380 Man. & Con. of Tx. Sy.	3
TC 412 Tex. Chem. Analysis II	3	TX 460 Phys. Prop. of Tex. Fibers	3
TC 491 Sem. in Tx. Chem.	1		
Tex. Chem. Elective*	5		15
	16		

* May be chosen from TC 400, The Science of Color; TC 401, Sources & Cont. of Poll. from Tex. Ind.; TC 505, Theory of Dyeing; TC 561, Organic Chemistry of High Polymers; TC 562 (CH 562), Physical Chemistry of High Polymers—Bulk Properties.

** May be deleted if taken elsewhere.

Students completing this program may continue to the graduate level if scholastic average is suitable.

GRADUATE STUDY

The Department of Textile Technology offers the Master of Science and the Master of Textile Technology degrees. Prospective applicants should consult the Graduate School Catalog.

TEXTILE RESEARCH

David Clark Laboratory

ROBERT W. WORK, *Director of Research*

Although research projects associated with the granting of advanced degrees constitute a vital part of the educational program, they form only a segment of the total research activities carried on in the school. In keeping with similar trends in American universities, an increasing volume of research is done. This is supported by the state and federal governments or is sponsored by private industry. Such research covers a wide gamut of problems having to do with textiles, fibers and polymers and ranges from the basic areas to the somewhat more applied. Thus, an atmosphere of scientific study and research endeavor permeates and is integral with the educational function of the school.

TEXTILES EXTENSION AND CONTINUING EDUCATION PROGRAM

D. S. HAMBY, *Acting Director*

WILLIAM H. HARD, *Assistant to the Director*

The extension and continuing education program of the School of Textiles is designed to serve the needs of the textile industry by disseminating research

findings and offering short courses for executive and scientific personnel in the industry.

The extension phase of the program is designed to form a close liaison between the research laboratories and programs of the School of Textiles and the management of the textile industry in the state. With the continued growth and expansion of research activities, it becomes increasingly important that these findings be transmitted to the industry as soon as possible for the most effective use of the scientific information.

The continuing education activities of the school range from seminars to two-week short courses. They range in scope from the highly scientific to the more practical level. A number of these courses are offered on a regular schedule and others are arranged as the need arises.

MACHINE DESIGN AND DEVELOPMENT

PAUL D. EMERSON, *Head*

C. M. ASBILL, JR., *Professor Emeritus*

Engineering assistance to faculty and students of the School of Textiles is provided by Machine Design and Development. This function includes textile engineering aspects of fiber production and processing, textiles manufacturing and testing, and mechanical and electronic instrumentation, as well as textile machinery design and development.

Complete facilities are available for design, construction and evaluation of experimental or developmental textile equipment.

Assistance to industry is provided in the form of consultation on matters relating to textile engineering, particularly in the field of noise measurement and control. The department also endeavors to remain current with recent engineering advances applicable to textiles and maintains active liaison with industry and the scientific community.

OFFICE OF STUDENT SERVICES

WILLIAM E. SMITH, *Director*

The Office of Student Services is responsible for the placement and financial aid programs of the School of Textiles. The placement function makes available to a potential employer the credentials of our students for permanent and summer employment and in a great number of cases performs equally for alumni.

The financial aid function operates by committee and makes it possible for any North Carolina student to pursue an education in textiles through scholarships, loans or grants as long as he maintains the academic and moral standards of the University.

The office is also responsible for representing the School of Textiles to the high schools in North Carolina through participating in the North Carolina Guidance and Personnel Association.

The director of the Office of Student Services is a member of the Executive Committee of the School of Textiles and is, to a great extent, the liaison between the student body and the student government with the administration of the school.

In general, it is the bridge between the academia and the extracurricular activities for the students.

BURLINGTON TEXTILES LIBRARY

J. G. BAKER, *Librarian*

The School of Textiles library was originally organized in 1944 as a branch of the D.H. Hill Library. In 1951, as a result of a substantial gift by Burlington Mills Foundation, the library was relocated in the west wing of the Nelson Building, and in 1965 the library was expanded, doubling the original space. This expansion was again made possible through the generosity of Burlington Industries, Inc.

Attractive furnishings and air-conditioning create an area conducive to study and research. The library has individual study carrels, a reading lounge, a reference/bibliography area and a seminar room. More shelving and storage have been provided for an ever-growing collection of textile books, journals, trade catalogs, patents and pamphlets. Typing facilities for students and photocopy services for users of the collection are available.

The library subscribes to various commercial indexing/abstracting services including *Chemical Abstracts*, *Textile Technology Digest*, and *World Textile Abstracts*.

The library lends to students, faculty and research staff of the institution, and will also lend to textile industry personnel. Interlibrary loan services are available to other institutions, and literature searching within reasonable limits is performed for qualified persons.

GRADUATE SCHOOL

WILLIAM S. WELLS, *Vice-president—Academic Affairs, Chapel Hill*

WALTER J. PETERSON, *Dean, North Carolina State University*

The Graduate School of the Consolidated University of North Carolina is composed of graduate divisions at campuses of the University located at Chapel Hill, Charlotte, Raleigh and Greensboro. Each division is administered by a graduate dean and an administrative board representing the various degree-granting areas. The Vice-president—Academic Affairs is the administrative officer of the Consolidated University who has responsibility for the development of policy in the graduate schools of the University system.

MASTER'S DEGREES

At North Carolina State University graduate instruction for the master's degree is offered in the fields of agriculture and life sciences and in various disciplines within design, education, engineering, forest resources, physical and mathematical sciences, and textiles. The Master of Science degree is offered in various disciplines within each of these areas. The professional master's degree, also offered in some of these fields, is intended for students who are interested in the more advanced applications of fundamental principles to specialized fields, rather than in the acquisition of the broader background in advanced scientific studies which fit them for careers in research. The Master of Arts is offered in economics, English, history and politics.

DOCTOR OF PHILOSOPHY AND DOCTOR OF EDUCATION DEGREES

The Doctor of Philosophy degree is offered in the following fields: animal science, biochemistry, biomathematics, biological and agricultural engineering, botany, chemical engineering, chemistry, civil engineering, crop science, economics, electrical engineering, engineering mechanics, entomology, statistics, fiber and polymer science, food science, forestry, genetics, industrial engineering, mathematics, mechanical and aerospace engineering, microbiology, materials engineering, nuclear engineering, nutrition, operations research, physics, physiology, plant pathology, psychology, sociology, soil science and zoology. The Doctor of Education degree is offered in adult education and occupational education.

Students interested in graduate study should consult the Graduate School Catalog which will be sent to them upon request. Inquiries should be addressed to: Dean of the Graduate School, North Carolina State University, Raleigh, North Carolina.

DIVISION OF CONTINUING EDUCATION

1911 Building

E. WALTON JONES, *Acting Director*

DAVID B. STANSEL, *Associate Director*

Assistant Directors: C. F. KOLB, M. E. STARNES; *Assistant to the Director:* H. H. ETHRIDGE; *Continuing Education Specialists:* N. B. BROYLES, K. R.

CRUMP, J. F. CUDD, JR., C. C. JONES, M. E. SHIELDS; *Regional Planning Specialist*: JOSEPHINE T. CROUSE; *Urban Affairs Specialist*: F. E. EMORY; *Technical Program Specialist*: J. B. GORDON; *Specialist in Aging*: SARAH S. AUMAN; *Social Services Specialist*: ANN W. TURNER

The Division of Continuing Education of North Carolina State University is the statewide adult education service linking the University, its scholars, research and resources with the people and communities of the State. Varying in length and format from one-day conferences and short courses to regular semester-length classes and educational television, continuing education's philosophy and objectives rest upon four premises:

To assist professional persons, scientists and engineers to stay abreast of the knowledge explosion in their particular fields.

To make available to each individual the opportunity to continue his or her higher educational advancement—either graduate or undergraduate.

To make available to each citizen the cultural advantages of the University so that each can broaden his horizons and make adjustments to our civilization.

To meet the educational needs of all the people who are not already served by other state institutions in ways consonant with the high academic standards of North Carolina State University.

Though increasingly designed for those who have been to college, many programs are open to any adult who can benefit from university-level study. The instructional staff consists of faculty from the University, from other institutions and outstanding authorities in many specific fields.

Only those programs appropriate to the standards of scholarship and instruction of North Carolina State University are offered as continuing education programs. Both credit and noncredit programs are offered on the University campus, in communities throughout the state and by correspondence instruction throughout the world.

CORRESPONDENCE COURSES

The division offers more than 48 different courses through its Bureau of Correspondence Instruction. Credit courses are offered in the following subject areas: agriculture, economics, education, engineering, English, geosciences, history, mathematics, modern languages, philosophy, political science, sociology and statistics. The correspondence bureau also has available high school review courses in English and mathematics. These courses can be utilized by persons who need to fulfill certain college entrance requirements, or by persons who have either scored poorly or need additional help on college entrance examinations.

CREDIT AND NONCREDIT EVENING CLASSES

The division offers, during the fall and spring semesters, a series of credit and noncredit courses on the University campus. The credit courses are sponsored and taught by the academic departments of the University and are generally conducted in the late afternoon and evening. These courses are offered to the already occupied mature person who is unable to attend classes during daytime hours. Generally speaking, approximately 110 courses in a variety of subject areas are offered each semester. The noncredit classes are designed for cultural and professional enrichment.

OFF-CAMPUS CREDIT CLASSES

Extension classes are offered in all sections of the state. These offerings are mainly on a need basis or by request from organizations or special groups.

Courses are available in almost all subject matter areas from engineering to the social sciences. During the previous year the division administered 72 credit classes in 48 different locations with registrations totaling over 1,270.

SHORT COURSES, INSTITUTES AND CONFERENCES

Variety and the necessity for providing educational opportunities for all the people of the state are the keystone to the division's offerings of short courses, institutes, conferences, etc. These programs, more than any others, mark the University's efforts to meet its land-grant tradition of providing education to all the people. The scope of the programs include: agriculture, engineering, forestry, textiles, the physical sciences, economics, management, communications, education and recreation. During the year 1969-70, there were 202 courses offered with registrations totaling over 11,250.

The North Carolina Truck Driver Training School (classified as a short course program) annually offers 12 four-week courses for professional truck drivers. The school is sponsored by the North Carolina Motor Carriers Association.

EDUCATIONAL TELEVISION

Television Center

JACK PORTER, *Director*

The North Carolina State University television facility is one of three educational television production centers on three campuses of the consolidated University of North Carolina. It produces programs for broadcast on the state-wide television network which is known as University of North Carolina Educational Television and which consists of WUNC-TV in the Central Piedmont, WUND-TV in Northeastern North Carolina, WUNG-TV in the Charlotte area, WUNE-TV in the Northwestern part of the state, and WUNF-TV in the Asheville area. Stations in other parts of North Carolina are under construction and expected to be operating by the time of publication. The NCSU ETV Center produces programs in agriculture, engineering, the arts, physical sciences and for special training of selected groups and individuals.

SUMMER SESSIONS

1911 Building

E. WALTON JONES, *Acting Director*

CHARLES F. KOLB, *Associate Director*

The Summer Sessions at North Carolina State University offers an extensive education program designed to meet the varied needs and interests of thousands of students who come to the campus each summer.

Each of the University's eight schools—represented by more than 50 different departments—offers instruction in over 400 courses, over 40 percent of which are at the graduate level. A faculty of more than 500 teachers participates in programs for summer study. Six of the eight schools offer regular courses during the two five-week terms; however, the School of Design offers one nine-week program and the School of Forestry conducts a summer camp for sophomores and two five-week practicums. In addition, there are many special programs and institutes offered during the summer by the University.

Summer courses and special programs are designed for the new student, the

undergraduate wanting to advance his academic standing at State, the graduate desiring to continue his study and research during the summer months, and the visiting student pursuing degrees at other institutions. The summer program can also be utilized by public school teachers who need to earn credit towards certificate renewal, and by persons in professional fields who simply wish to keep abreast of new developments and trends in their particular area of endeavor. There is also the opportunity to take required subcollege level work in English and mathematics for those seeking to enroll at the University.

Students seeking information regarding any of the University's summer activities should contact: Director of Summer Sessions, North Carolina State University, Post Office Box 5125, Raleigh, North Carolina 27607

URBAN AFFAIRS AND COMMUNITY SERVICES CENTER

1911 Building

E. WALTON JONES, *Acting Director*

Associate Directors: W. L. FLOWERS, JR., W. G. ROBERTS, JR.

The center is the focal point for a campus-wide research, education and community service program which is designed to enable North Carolina State University to respond more effectively to the problems of our urbanizing society. The program encourages multidisciplinary participation by faculty and students with a high priority being given to the service-learning concept. Through the auspices of the center, representatives from federal, state and local governmental units, as well as private agencies, can join with University personnel in working on problems of mutual concern. Program areas now receiving attention include housing, human resources development, volunteerism, child development, urban renewal, social services, environmental quality and regionalism. The center program is closely coordinated with the work being done at other branches of the University as well as that of other educational institutions.

COMPUTING CENTER

LEROY B. MARTIN, JR., *Director*

North Carolina State University is one of the three universities participating in the Triangle Universities Computation Center (TUCC). This internationally known facility is located in the Research Triangle Park 15 miles from Raleigh. The other participating universities are The University of North Carolina at Chapel Hill and Duke University at Durham.

The central equipment located at TUCC is an IBM System 360, Model 75 with 3.0 million characters of memory. In addition, 452 million characters of on-line storage are available as well as extensive teleprocessing equipment for communication with the member universities and other institutions throughout the state.

Each university has one high-speed terminal as well as several other medium and low-speed devices located in key positions on the campus. The input-output terminals are connected to the Model 75 by telecommunication lines.

The high-speed terminal at North Carolina State University is an IBM 360, Model 40 located at the Computing Center in the Nelson Textile Building. It provides simultaneous local computing and communication with TUCC. Many other terminals, both small computers and typewriter-type, are located on the

campus. They and the Model 40 are used for faculty and student research and for instruction in scheduled credit courses and noncredit short courses.

COMPUTER SERVICE

The revolutionary effect of computers and information processing systems on our economy and society has become so great during the last decade that a corresponding gap in our educational program has become evident. Modern business, industry, military and government have been forced to reorganize their procedures and methods of operation in lines compatible with automation.

The use of digital and analog computers is widespread and new applications appear at a very high rate. Because of the ever increasing importance of computers in business and industry there is an accelerating demand for college graduates who are capable and trained to handle the problems associated with computation.

MILITARY TRAINING

DEPARTMENT OF MILITARY SCIENCE (ARMY ROTC)

Professor: COLONEL W. L. BOYLSTON; *Instructors:* LTC D. F. BOYER, LTC R. E. CONROY, CPT R. G. MOORE, JR., CPT B. A. SIMS, CPT P. J. TUOHIG, CPT T. J. YOUNG, JR.

DEPARTMENT OF AEROSPACE STUDIES (AIR FORCE ROTC)

Professor: COLONEL O. T. REEVES; *Assistant Professors:* CAPT. A. G. ARNSDORFF, JR.; *Instructors:* CAPT. H. M. BADDLEY, JR., CAPT. C. T. FARMER

OBJECTIVES

The Reserve Officers' Training Corps designates those students enrolled for training in the Department of Military Science (Army ROTC) or in the Department of Aerospace Studies (Air Force ROTC). These departments are integral but separate academic and administrative subdivisions of the institution.

The mission of the Army ROTC is to produce junior officers who by their education, training and inherent qualities are suitable for continued development as officers in the United States Army.

The mission of the Air Force Reserve Officer Training Corps (AFROTC) is to produce officers of appropriate quality to satisfy stated Air Force officer requirements.

COURSE OF INSTRUCTION

Army ROTC—The program of instruction for the Army ROTC consists of a two-year basic course and a two-year advanced course. Also available is a two-year program is designed for junior college graduates, and students at four-year colleges who were unable to take ROTC during their first two years of college.

Air Force ROTC—The program of instruction for the Air Force ROTC consists of a two-year General Military Course, Field Training Course and a two-year Professional Officer Course.

The University provides, in cooperation with the Air Force and the Army, a flight instruction program. A limited number of highly qualified cadets from both ROTC units participate in this instruction which includes approximately

361½ hours of flying in light aircraft plus ground school. Successful completion of this phase of the ROTC course will insure continued participation in military flying training programs and may qualify cadets for a Federal Aviation Agency private pilot's certificate.

Satisfactory completion of the advanced courses qualifies a student for commissioning as a second lieutenant in the Army or Air Force Reserve upon graduation from the University. A detailed description of all military courses is given under each of the departments in the section of the catalog which lists course descriptions.

ARMY ROTC

The selection of advanced-course students is made from applicants who are physically qualified and who have above average academic and military records. Veterans who have one year or more of service in the Armed Forces are eligible for enrollment in the Army ROTC advanced course upon reaching their junior year, provided they are in good academic standing, physically qualified, have not reached their 27th birthday and are selected by the PMS and the University administration.

The Army ROTC course includes instruction in American military history, map reading, leadership, military teaching methods, military justice, troop movements, the role of the U. S. in world affairs, administration, operations and logistics. These subjects not only prepare students to be officers in the United States Army, but also awaken in them an appreciation of the obligations of citizenship and secure for them personal benefits resulting from practical application of organization and responsible leadership. An elective subject is chosen from general academic areas for utilization in the junior and senior years.

AIR FORCE ROTC

A student enrolled in the Air Force ROTC may pursue a four-year program with Air Force Scholarship, a four-year program without scholarship, or a two-year program.

Freshman students may be required to meet certain Air Force prescribed physical standards for entry into the General Military Course.

Students, to meet enrollment requirements, must achieve the minimum Air Force Officer Qualification Test (AFOQT) qualifying score required for entry into the Professional Officer Course, meet necessary physical requirements, and have above average academic records. Qualified veterans desiring a commission through the Air Force program are required to complete the two-year advanced program. Nonveterans must complete two years of General Military Studies, the two-year Professional Officer Course, and attend four weeks of field training AS 254 or successfully complete the six-week field training course, AS 256, and the two-year Professional Officer Course prior to their 30th birthday to qualify for a commission.

UNIFORMS

Uniforms for Army and Air Force ROTC are provided by the University from Commutation Funds paid by the Federal Government.

CREDIT

Credit is allowed for work at other institutions having an ROTC unit established in accordance with the provisions of the National Defense Act and regulations governing the ROTC. Record of a student's prior training in the ROTC is obtained from the institution concerned.

FINANCIAL AID

Army ROTC—Two- and four-year scholarships are available to selected Army ROTC students who are strongly motivated toward a career in the Army. Each scholarship pays for tuition, books and laboratory expenses, and the student receives \$50.00 a month for the duration of the scholarship.

Air Force ROTC—A limited number of selected students enrolled in the Air Force ROTC program may qualify for scholarships. All scholarships pay \$50.00 a month plus tuition, fees and a \$75.00 per academic year book allowance. In addition there is a contract program; in this program, students in the last two years will receive a retainer fee of \$50.00 per month.

For summer training of four to six weeks, students will receive pay and travel allowance. Students in the basic or general course receive no monetary allowance.

ORGANIZATION OF THE ROTC

Army—The Army ROTC unit at North Carolina State University consists of a cadet brigade, commanded by a cadet colonel, and comprised of a support battalion and numbered battalions. The cadet colonel and all other cadet officers are selected from students enrolled in the second year advanced course. Cadet sergeant majors, first sergeants and sergeants first class are appointed from students enrolled in the first year advanced course. Certain specially selected students in the second year basic course also are appointed as cadet non-commissioned officers. Cadet officers and noncommissioned officers obtain invaluable experience in leadership by being responsible for conducting all drill instruction. They are observed and supervised in this by the officers and noncommissioned officers of the Army assigned to the University.

Air Force—The Air Force ROTC unit is organized as a cadet group (commanded by a cadet colonel) with an appropriate number of squadrons; the squadrons are composed of flights and squads. The group, squadron and flight commanders and their staff are cadet commissioned officers and are selected from cadets enrolled in the Professional Officers Course. All other positions are held by cadet noncommissioned officers who are selected from General Military Course cadets. Cadet officers and noncommissioned officers obtain invaluable experience in leadership by being responsible for planning and conducting all aspects of the cadet group operations. They are observed and supervised by the officers and airmen assigned to the University.

There is also an Army and Air Force Drum and Bugle Corps which is composed of cadets from each unit; the corps performs at ceremonies and drills for the Brigade and the group represents North Carolina State at selected public appearances.

DISTINGUISHED STUDENTS

The University is authorized to name outstanding students of the Army ROTC and Air Force ROTC as Distinguished Military Students or Distinguished Air Force ROTC Cadets. These students may, upon graduation, be designated Distinguished Military Graduates or Distinguished Air Force ROTC Graduates and may be selected for commission in the regular Army and Air Force, provided they so desire.



COURSE DESCRIPTIONS

In a typical course description, the semester hours of credit, the number of actual lecture and laboratory hours of meeting per week, and the term or terms in which the course is offered are shown in this manner: 2(1-2) F S Sum. or 1-3 F S Sum.

The 2 indicates the number of semester hours credit given for satisfactory completion of the course. The (1-2) indicates that the course meets for one hour of lecture and for two hours of laboratory work each week. The 1-3 indicates that a maximum of 3 and a minimum of 1 semester hours credit can be earned. This is to be arranged with the instructor. The F designates the course to be given the fall semester. Likewise, the S designates spring and the Sum., summer.

Waiver of prerequisites is at the discretion of the instructor.

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ADULT AND COMMUNITY COLLEGE EDUCATION

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 501 (SOC 501) LEADERSHIP 3 (3-0) S
(See sociology, page 431.)

ED 502 (PS 502) PUBLIC ADMINISTRATION 3 (3-0) S
(See politics, page 413.)

ED 503 THE PROGRAMMING PROCESS IN ADULT EDUCATION 3 (3-0) S
Prerequisites: ED 501, consent of instructor

The principles and processes involved in programming, including basic theories and concepts supporting the programming process. Attention will be given to the general framework in which programming is done, the organization needed and the program roles of both professional and lay leaders. Mr. Boone

ED 510 ADULT EDUCATION: HISTORY, PHILOSOPHY, CONTEMPORARY NATURE 3 (3-0) F

Prerequisite: Graduate standing

A study of the historical and philosophical foundations of adult education from ancient times to the present, giving attention to key figures, issues, institutions, movements and programs, including consideration of the relationship between adult education's historical development and prevailing intellectual, social, economic and political conditions. Consideration of adult education's contemporary nature, present-day schools of thought on its objectives and trends. Mr. Russell

ED 513 (SOC 513) COMMUNITY ORGANIZATION 3 (3-0) S
(See sociology, page 433.)

ED 559 PRINCIPLES OF ADULT EDUCATION 3 (3-0) F
Prerequisite: Six hours in education

Principles involved in adult education programs including theories and concepts undergirding and requisite to these programs. Emphasis will be given to the interrelationship of the nature of adult learning, the nature of the subject matter and the setting in which learning occurs. The applicability of relevant principles and pertinent research findings to adult learning will be thoroughly treated. Mrs. Quinn

ED 596 TOPICAL PROBLEMS IN ADULT EDUCATION

Credits Arranged

Prerequisite: Graduate standing

Study and scientific analysis of problems in adult education, and preparation of a scholarly research type of paper.

Graduate Staff

FOR GRADUATES ONLY**ED 600 THEORY OF ORGANIZATION AND ADMINISTRATION IN
ADULT EDUCATION I**

3 (3-0) F

**ED 601 THEORY OF ORGANIZATION AND ADMINISTRATION IN
ADULT EDUCATION II**

3 (3-0) S

ED 696 SEMINAR IN ADULT EDUCATION

1 (1-0) F S

AGRICULTURAL EDUCATION**FOR UNDERGRADUATES****ED 102 OBJECTIVES IN AGRICULTURAL EDUCATION**

1 (1-0) F

Designed to help the student understand the purpose of agricultural education at North Carolina State. Also provides an opportunity for students to develop an understanding of purposes of vocational agriculture and other programs of education in agriculture.

Mr. Mercer

ED 313 CONTEMPORARY VOCATIONAL AGRICULTURE

3 (3-0) F S

The contemporary program of vocational agriculture is examined in depth in relation to changing and expanding career opportunities in agricultural education. Study is directed to the continuing adjustment of the program objectives, curriculum organization, content of courses, teaching practices, instructional resources and evaluation emphasis in modern programs in vocational agriculture. Prerequisite for student teaching in agricultural education.

Mr. Bryant

ED 411 STUDENT TEACHING IN AGRICULTURE

6 (2-15) F S

Prerequisites: ED 344, PSY 304, senior standing, admission to teacher education and an overall 2.0 average.

The first part of the semester, six or seven weeks, will be on campus. The remainder of the semester will be spent in a high school doing full-time student teaching. The student will get experience in all phases of the vocational agriculture program, including community study, adult education and home supervision. The student teacher will be supervised by the local teacher of agriculture and a member of the staff in agricultural education.

Mr. Mercer

ED 412 TEACHING ADULTS

2 (1-2) F S

Principles of effective teaching applied to adults. Experience in organizing and conducting groups for discussion of local problems.

Staff

ED 413 PLANNING EDUCATIONAL PROGRAMS

2 (1-2) F

Principles of program planning applied to educational programs in agriculture. Resources needed for adequate planning. Field work in planning programs.

Staff

ED 490 SENIOR SEMINAR IN AGRICULTURAL EDUCATION**1 (1-0) S**

An analysis of the opportunities and problems facing educational leaders in agriculture with particular emphasis upon current problems.

Staff**FOR GRADUATES AND ADVANCED UNDERGRADUATES****ED 554 PLANNING PROGRAMS IN AGRICULTURAL EDUCATION****3 (3-0) F S****Prerequisite:** ED 411 or equivalent

Consideration of the need for planning programs in education; objectives and evaluation of community programs; use of advisory group; organization and use of facilities.

Mr. Bryant**ED 565 AGRICULTURAL OCCUPATIONS****3 (3-0) F S****Prerequisite:** ED 411

The theory of education and work is related to the expanding field of agricultural occupations. Career development in agricultural occupations is associated with curriculum development needs. Occupational experience in agriculture is seen in relation to the curriculum and to placement in agricultural occupations.

Messrs. Miller, Scarborough**ED 566 OCCUPATION EXPERIENCE IN AGRICULTURE****3 (3-0) F S****Prerequisite:** ED 411

A major and critical element in all programs of vocational education is the provision for appropriate student learning experiences in a real and simulated employment environment. Due to recent developments in education and agriculture, new and expanded concepts of occupational experience have been devised. Current research substantiates the need and desire of teachers of agriculture for assistance in implementing the new concepts. The course is designed not only to provide this aid but to develop a depth of understanding of the theoretical foundations underlying the new developments in occupational experiences to stimulate individual growth and creativity in implementing further developments.

Mr. Miller**ED 568 ADULT EDUCATION IN AGRICULTURE****3 (3-0) F S****Prerequisite:** ED 411 or equivalent

Designed to meet the needs of leaders in adult education. Opportunity to study some of the basic problems and values in working with adult groups. Attention will be given to the problem of fitting the educational program for adults into the public school program and other educational programs as well as to the methods of teaching adults.

Mr. Scarborough**ED 593 SPECIAL PROBLEMS IN AGRICULTURAL EDUCATION****Credits Arranged****Prerequisite:** ED 411 or equivalent

Opportunities for students to study current problems under the guidance of the staff.

Staff**FOR GRADUATES ONLY****ED 617 PHILOSOPHY OF AGRICULTURAL EDUCATION****3 (3-0) S****ED 664 SUPERVISION IN AGRICULTURAL EDUCATION****3 (3-0) F S****ED 688 RESEARCH APPLICATION IN OCCUPATIONAL EDUCATION****3 (3-0) F S****ED 689 EVALUATION IN OCCUPATIONAL EDUCATION****3 (3-0) F S**

ED 693	ADVANCED PROBLEMS IN AGRICULTURAL EDUCATION	Credits Arranged
ED 694	SEMINAR IN AGRICULTURAL EDUCATION	1 (1-0) F S Maximum 2
ED 699	RESEARCH	Credits Arranged

AGRICULTURE AND LIFE SCIENCES

(General Courses)

ALS 103	ORIENTATION	1 (0-2) F
An introduction to the scope and objectives of a university education with emphasis on the sciences particularly as related to biology and agriculture. Guest lecturers and laboratory demonstrations.		
		Mr. Glazener

ALS 299	SUPERIOR STUDENT SEMINAR	1 S Maximum 2
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A seminar program open only to freshmen and sophomore students in the honors program.

ALS 499	HONORS STUDENT RESEARCH	1-3 S Maximum 6
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A research program open only to students in the honors program.

AC 311	COMMUNICATIONS METHODS AND MEDIA	3 (3-0) S
Prerequisites: ENG 111, ENG 112		

Designed to give an insight into the communications process: written, oral and visual techniques of communications; a survey of the channels of communications available; principles and techniques for using these channels individually or combined into a publicity, promotion, public relations, information or advertising program.

Mr. Carpenter

ANIMAL SCIENCE

FOR UNDERGRADUATES

ANS 200	INTRODUCTION TO ANIMAL SCIENCE	4 (3-3) FS
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A study of the fundamental principles of dairying and of meat animal production. The importance of dairy and meat products in the human diet and in the state and national economy is emphasized.

Messrs. Goode, Rakes

ANS 204	LIVESTOCK FEEDS AND FEEDING	3 (2-3) S
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An introduction to applied animal nutrition, including the structure and function of the digestive tract, the nutrient value and classification of feedstuffs and the nutrient requirements and formulation of livestock rations.

Mr. Alsmeyer

ANS 301 (FS 301, NTR 301)	NUTRITION AND MAN	3 (3-0) FS
Prerequisites: Two years of college work		

The significance of nutrition in the health, welfare and behavior of man; a study of the basic principles relating to practical problems in the provision

and utilization of adequate nutrients for individuals and populations living under various environmental conditions. Messrs. Wise, Aurand

ANS 302 SELECTING DAIRY AND MEAT ANIMALS 2 (0-6) F

Market classes and grades of beef cattle, swine and sheep are used to study live animal-car cass value interrelationships. Breed histories, pedigree evaluation and the desired characteristics of dairy cattle, meat animals and quarter horses are examined. Messrs. Harvey, Wilk

ANS 308 ADVANCED SELECTING DAIRY AND MEAT ANIMALS 1 (0-3) S
Prerequisite: ANS 302 or consent of instructor

An advanced study of dairy and meat animal selection, including the relationships between the live animal and its carcass. Included is intensive practice to develop proficiency in the selection of market and purebred livestock. Field trips are made to leading farms in order to study outstanding animals of the various breeds. Messrs. Harvey, Wilk

FOR ADVANCED UNDERGRADUATES

ANS 401 REPRODUCTIVE PHYSIOLOGY 3 (2-3) S
Prerequisite: ZO 421

A review of current concepts of physiology as they relate to mammalian reproduction. Emphasis is placed upon understanding physiological processes, how they are influenced by external forces and their importance in reproductive performance. The student may be required to select, design and conduct a special research project. Mr. Myers

ANS 402 BEEF CATTLE MANAGEMENT 3 (2-3) S
Prerequisite: ANS 204

A study of modern principles and practices in beef cattle care and management. Special emphasis is placed upon application of the principles of genetics, ruminant nutrition and animal health to cow-calf programs and to stocker and feeder cattle operations. Mr. Harvey

ANS 403 SWINE MANAGEMENT 3 (2-3) S
Prerequisite: ANS 204

A study of the economic, nutritional, genetic, physiological and managerial factors affecting the operation of modern swine enterprises. Mr. Clawson

ANS 404 DAIRY CATTLE MANAGEMENT 3 (2-3) S
Prerequisite: ANS 204

A study of practical dairy farm management, including feed acquisition and utilization, breeding and selection, health and sanitation, milking herd replacements and dairy farm buildings with particular emphasis on the consequences of management alternatives and the importance of herd and farm business records. (Offered spring 1972 and alternate years.) Mr. Davenport

ANS 405 LACTATION 3 (2-3) F
Prerequisite: ZO 421

An examination of the gross and microscopic anatomy of the developing and mature mammary gland. Physiological processes involved in milk secretion and the removal of milk from the gland are studied. A special research problem is required. Mr. Mochrie

ANS 406 SHEEP MANAGEMENT 3 (2-3) F

Prerequisite: ANS 204

A study of the economic, genetic, nutritional, physiological and managerial factors affecting the operation of the modern sheep enterprise. Mr. Goode

ANS 409 (FS 409) MEAT AND MEAT PRODUCTS 3 (2-3) S

(See food science, page 318.)

ANS 410 HORSE MANAGEMENT 2 (2-0) F

The application of the fundamentals of selection, nutrition, breeding and animal health to light horses. Managerial details in caring for horses are covered. Mr. Barrick

ANS 411 BREEDING AND IMPROVEMENT OF DOMESTIC ANIMALS 3 (2-2) F

Prerequisite: GN 411

Genetic principles are stressed in relation to the improvement of economically important domestic species. Emphasis is given to the specific requirements of breeding plans for individual species. Mr. Legates

ANS 415 (NTR 415, PO 415) COMPARATIVE NUTRITION 3 (3-0) F

Prerequisite: CH 220 or CH 221

A study of the fundamentals of animal nutrition, including the classification of nutrients; their requirement and general metabolism by different species for health, maintenance, growth and other productive functions.

Messrs. Ramsey, Donaldson

ANS 490 ANIMAL SCIENCE SEMINAR 1 (1-0) S

A review and discussion of special topics and current literature pertaining to all phases of animal science. Mr. Porterfield

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ANS 502 (PHY 502) REPRODUCTIVE PHYSIOLOGY OF VERTEBRATES 3 (3-0) S

Prerequisite: ZO 421 or consent of instructor

Emphasis is placed upon discussion of mechanisms which control the reproductive processes. Mechanisms which are species limited are compared with those which are shared by all. Current knowledge of some subsystems is investigated in detail, while others are referred to in reviews of well-documented research findings. Mr. Ulberg

ANS 505 DISEASES OF FARM ANIMALS 3 (3-0) F

Prerequisites: CH 101, CH 103

The pathology of bacterial, viral, parasitic, nutritional, thermal and mechanical disease processes is examined. Mr. Batte

ANS 508 (GN 508) GENETICS OF ANIMAL IMPROVEMENT 3 (3-0) S

Prerequisites: GN 411, ST 511

Emphasis is placed upon the utilization of basic principles of population and quantitative genetics in animal improvement. Factors affecting genic and genotypic frequencies and methods of estimating genetic and nongenetic variance, heritabilities and breeding values are presented. The roles of mating systems and selection procedures in producing superior genetic populations are examined.

Mr. Robison

ANS 590 TOPICAL PROBLEMS IN ANIMAL SCIENCE	Maximum 6 FS
Special problems are selected or assigned in various phases of animal science.	
	Graduate Staff

FOR GRADUATES ONLY

ANS 603 (GN 603) POPULATION GENETICS IN ANIMAL IMPROVEMENT	3 (3-0) F
ANS 604 (PHY 604) EXPERIMENTAL ANIMAL PHYSIOLOGY	4 (2-4) F
ANS 622 (ST 622) PRINCIPLES OF BIOLOGICAL ASSAYS	3 (3-0) S
ANS 653 (BCH 653) MINERAL METABOLISM	3 (3-0) F
ANS 690 SEMINAR IN ANIMAL NUTRITION	1 (1-0) FS
ANS 699 RESEARCH IN ANIMAL SCIENCE	Credits Arranged FS

ANTHROPOLOGY

(Also see Sociology)

FOR UNDERGRADUATES

ANT 251 PHYSICAL ANTHROPOLOGY	3 (3-0) F S
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The study of the development of man as a species; analysis of the formation and spread of races; introduction to archaeology as a study of the material remains of ancient man and his activities.

ANT 252 CULTURAL ANTHROPOLOGY	3 (3-0) F S
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The analysis of various living societies and their cultures in terms of social adjustment to recurrent needs.

ANT 305 PEOPLES OF THE WORLD	3 (3-0) F S
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This course seeks to develop insights of wide applicability concerning human relationships and the adjustment of man to his geographical, social and cultural environments. The course is designed to demonstrate interrelationships among diverse factors affecting human behavior in all societies.

ANT 410 THEORIES OF CULTURE	3 (3-0) F S
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Prerequisites: Six hours sociology, ANT 252 or equivalent

The study of major anthropological theories of culture with intensive analysis of their application.

ANT 416 FIELD METHODS IN CULTURAL ANTHROPOLOGY	3 (3-0) F S
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Prerequisite: Six hours anthropology

I. To provide a systematic experience with anthropological field techniques, i.e., community mapping; household census; kinship analysis; life-history recording; participant observation; inventory of material culture; child rearing observations. II. To furnish an opportunity to use conventional anthropological field tools, i.e., tape recorder, motion picture camera, still camera, fieldwork journal, unstructured interview. III. Through textbooks and supplementary reading, students will become familiar with anthropologists' reports of their own field methods and the problems they encountered.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ANT 512 APPLIED ANTHROPOLOGY

3 (3-0) F S

Prerequisite: ANT 252 or consent of instructor

The course includes a review of the historical development of applied anthropology and a study of anthropology as applied in government, industry, community development, education and medicine. The processes of cultural change are analyzed in terms of the application of anthropological techniques to programs of developmental change.

ARCHITECTURE

ARC 300 HISTORIC ARCHITECTURE RESEARCH

2 FS

Prerequisite: DN 202

Research and the recording of sites, monuments, buildings or artifacts of historical interest.
Mr. Reuer

ARC 331 ENVIRONMENTAL BUILDING SYSTEMS

2 (1-3) FS

The establishment and development of the concept of building as an environmental control mechanism, i.e., as a barrier between the natural environment and the activities and human needs to be accommodated. A description of environmental factors upon which the science of building construction is based. An investigation of basic building materials, their properties, processes of production and principal systems of enclosure. Consideration will also be given to economic factors and legal controls.
Mr. Kayari

ARC 332 ENVIRONMENTAL CONTROL SYSTEMS

2 (1-3) FS

A study of the basic systems used to control the environment: air, heat, light, sound and sanitation. Emphasis placed upon the principles and the conceptual understanding of each system through comparative analysis of the system's characteristics and the investigation of the effect of each system on architectural form.
Mr. Barnes

ARC 400 INTERMEDIATE ARCHITECTURAL DESIGN (SERIES)

4 (1-9) FS

Prerequisite: DN 202 or equivalent or consent of department

Design investigations aimed at the development of an understanding of the major issues confronting the contemporary architect and at the expanding of problem solving abilities in architectural design. Students must complete four semesters to satisfy this requirement, selecting from a number of vertically organized workshops which offer on an optional basis a wide range of program emphases.
Staff

ARC 431 INDUSTRIALIZED SYSTEM BUILDING

2 (1-3) FS

Prerequisite: ARC 331

An analytic study of mass produced building systems to examine the implications, limitations and potentials of this type of architecture. The analysis is to include design, factory processes, distribution methods, fabrication, erection and economic analysis.
Mr. Kayari

ARC 432 CLIMATE CONTROL SYSTEMS AND DESIGN

2 (1-3) F

Prerequisite: ARC 332

Further study of the mechanical systems used for heating, cooling, ventilating and conditioning the interior of buildings. The analysis and design of the climate control system for a small-scale building will be undertaken in this course.
Mr. Barnes

ARC 433 ILLUMINATION DESIGN**2 (1-3) S****Prerequisite:** ARC 332

Examination of interior and exterior lighting design, including vision, color, sources and control.
Mr. Barnes

ARC 441 DESIGN METHODS**2 (2-0) FS**

Description, comparisons and testing of the various methods which are available in architectural design with emphasis on problem-solving techniques. The method is primarily a means for integrating rational analysis and creative thought in the design act.
Staff

ARC 491 SPECIAL PROJECTS IN ARCHITECTURE**1-4 FS****Prerequisite:** Junior standing

Investigation of special projects by interdisciplinary groups or individuals in various phases of architecture.
Staff

ARC 495 SPECIAL PROBLEMS IN ARCHITECTURE**1-3 FS****Prerequisite:** Junior standing

Special problems in various aspects of architecture developed under the direction of a faculty member on a tutorial basis.
Staff

ARC 499 ARCHITECTURE SEMINAR**1-3 FS****Prerequisite:** Consent of department

Presentations and discussions of special areas of interest in architecture and the allied design fields.
Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES**ARC 501, 502 ADVANCED ARCHITECTURAL DESIGN I, II****6 (3-9) FS****Prerequisites:** (501) 16 credits of ARC 400 or equivalent; (502) ARC 501

Advanced studies in architectural design in which are investigated large-scale architectural problems having complex functional, social and economic implications; special emphasis is given to problem identification, program formulation and application of advanced design methods.
Messrs. Batchelor, Burns, Sanoff

ARC 511 PROFESSIONAL PRACTICE I**2 (2-0) F****Prerequisite:** Fourth year standing

The evolution of architecture as a modern practical profession; obligations of the profession to society and to itself; the legal and ethical position of the architect in practice; comparative study of documents; the architect's working organization; emerging techniques of office practice.
Staff

ARC 512 PROFESSIONAL PRACTICE II**2 (2-0) S****Prerequisite:** Fourth year standing

Continuing study of standard documents and emerging techniques of practice, with emphasis on the principles and improved techniques of writing construction specifications; interrelationship of The Contract Documents; comparative study of techniques for controlling competitive bidding.
Staff

ARC 521, 522 ARCHITECTURAL STRUCTURES I, II**3 (3-0) FS****Prerequisites:** (521) CE 339; (522) ARC 521

Gravity and nongravity loads on structures; comparative behavior of structural materials; comparative behavior of simple structural systems; approximate and exact analysis procedures as applied to systems; principles of approximate and

exact design in timber, steel and reinforced concrete; architectural/structural/mechanical compatibility in systems; basic principles of foundation analysis and design. Mr. Brantly

ARC 531, 532 ADVANCED BUILDING TECHNOLOGY I, II 2 (1-3) FS
Prerequisites: ARC 331, ARC 332

A synthesis of studies in building science undertaken in previous courses. Material assemblies in practical application, dimensional characteristics of mechanical and construction systems for buildings and special projects in selected areas of building science.

ARC 551 RESEARCH METHODS IN ARCHITECTURE 2 (2-0) FS
Prerequisite: Graduate standing

Seminar on the quantitative methods from various disciplines towards the scientific inquiry of knowledge. Analysis of techniques and instruments appropriate in solving problems involving scaling, measurement, modeling and gaming within the scope of the physical environment. Staff

FOR GRADUATES ONLY

ARC 601, 602 ADVANCED ARCHITECTURAL DESIGN III, IV 6 (3-9) FS

ARC 621, 622 ARCHITECTURAL STRUCTURES III, IV 2 (1-3) FS

ARC 691, 692 SPECIAL TOPICS IN ARCHITECTURE 1-6 FS

ART

ART 200 THE VISUAL ARTS IN CONTEMPORARY LIFE 3 (3-0) F

The study of painting, sculpture, art, crafts and the useful arts of commerce. Also, the study of the aesthetic nature of man from the standpoint of creativity and appreciation; relation of present day creative efforts of man with those of the past—giving the student an understanding of today's visual arts.

Mr. Cox

BIOCHEMISTRY

FOR UNDERGRADUATES

BCH 351 ELEMENTARY BIOCHEMISTRY 3 (3-0) S
Prerequisite or corequisite: CH 223

An elementary survey of the chemistry of living systems. Mr. Armstrong

BCH 452 EXPERIMENTAL BIOCHEMISTRY 3 (1-6) F
Prerequisite: BCH 351 or corequisite BCH 551; quantitative chemical analysis recommended

An introduction to fundamental techniques of biochemistry and molecular biology involving experimental study of carbohydrates, lipids, proteins, enzymes, nucleic acids, metabolism and metabolic controls. Mrs. Theil

FOR GRADUATES AND ADVANCED UNDERGRADUATES

BCH 551 GENERAL BIOCHEMISTRY 3 (3-0) F
Prerequisites: Three years chemistry, including CH 223; CH 431 strongly recommended

Principles of modern biochemistry, including a study of structural and metabolic relationships of carbohydrates, lipids, proteins, nucleic acids, enzymes and coenzymes. Mr. Jones

BCH 554 RADIOISOTOPE TECHNIQUES IN BIOLOGY 2 (1-3) F
Prerequisites: BCH 551 or CH 433 or CH 435

The theory and application of the radioisotope techniques used in biology. The different modes of radioactivity are correlated with methods of measurement. Emphasis is placed on the use and limitations of various instruments and techniques and on their application to research problems. Mr. Sisler and Staff

BCH 557 INTRODUCTORY ENZYME KINETICS 3 (3-0) S
Prerequisites: BCH 551 and MA 201 or MA 212

The basic principles of chemical kinetics applied to the development of enzyme kinetics. Limitations of the Michaelis equation are considered in the light of the general rate equation. Inhibition and activation, pH functions, effects of temperature, and elucidation of mechanisms are also considered. Mr. Main

BCH 561 (GN 561, MB 561) BIOCHEMICAL AND MICROBIAL GENETICS 3 (3-0) F
Prerequisites: BCH 351 or BCH 551, GN 411 or GN 505, MB 401 or equivalent

A study of the development of the fields of biochemical genetics and microbial genetics emphasizing both techniques and concepts currently used in research in these areas. Includes lectures and discussions of current research publications. Mr. Armstrong

FOR GRADUATES ONLY

BCH 651 PHYSICAL BIOCHEMISTRY 3 (3-0) S

BCH 652 BIOCHEMICAL RESEARCH TECHNIQUES 3-5 S

BCH 653 (ANS 653) MINERAL METABOLISM 3 (3-0) F

BCH 655 INTERMEDIARY METABOLISM I 3 (3-0) S

BCH 657 INTERMEDIARY METABOLISM II 3 (3-0) F

BCH 659 (CH 659) NATURAL PRODUCTS 3 (3-0) F

BCH 691 SEMINAR IN BIOCHEMISTRY 1

BCH 695 SPECIAL TOPICS IN BIOCHEMISTRY Credits Arranged

BCH 699 BIOCHEMICAL RESEARCH Credits Arranged

BIOLOGICAL AND AGRICULTURAL ENGINEERING

FOR UNDERGRADUATES

BAE 211 FARM MACHINERY

4 (2-4) F S

The study of farm machinery which begins with the materials of construction as they are related to design, cost, fabrication process, tools and techniques involved in construction, repair and maintenance, machine performance, reliability, machine capabilities and limitations. The operation, service and adjustment of the machine will be studied by an analysis of the requirements to do the job for which it was designed, and consideration of the conditions under which it must operate. The selection, management and economics of owning and operating machinery is emphasized.

Mr. Howell

BAE 251 ELEMENTS OF BIOLOGICAL AND AGRICULTURAL ENGINEERING

3 (2-3) F

Prerequisite: Enrollment in SBE curriculum

Elements of Biological and Agricultural Engineering is a course designed to introduce agricultural engineering students to pertinent topics basic to this field of study and to some of the current progress relating to the different subject areas. In addition students will be introduced to various engineering procedures, tool processes and materials utilized by the agricultural industries.

Mr. Blum

FOR ADVANCED UNDERGRADUATES

BAE 303 ENERGY CONVERSION FOR AGRICULTURAL PRODUCTION

2 (2-0) F

Prerequisites: BS 100, MA 112 or MA 201, PY 211 or PY 205

Energy transformations and exchanges of plants and animals are studied on the basis of physical theories and principles. Specific examples in thermal radiation, convection, conduction, phase changes, muscle work, photosynthesis and respiration.

Mr. Suggs

BAE 321 IRRIGATION, TERRACING AND EROSION CONTROL

3 (2-3) S

Prerequisite: Junior standing

A study of the principles of soil and water conservation engineering. Topics discussed are: surface and subsurface drainage, farm ponds, hydraulics of open channels, irrigation, soil erosion, conservation practices, and the use of basic surveying equipment.

Staff

BAE 331 (FS 331) FOOD ENGINEERING

3 (2-3) F

(See food science, page 318.)

BAE 332 FARM STRUCTURES

3 (2-3) S

Prerequisite: PY 211 or PY 221

This course is designed to acquaint the student with the role of farm structures in a rapidly changing agricultural situation. This, in turn, requires study of environmental relationships, materials flow, structural features, design techniques, construction materials, and construction procedures. Emphasis is placed on relating the theory to practical applications encountered in problem situations.

Mr. Blum

BAE 341 FARM ELECTRIFICATION AND UTILITIES

3 (2-3) S

Corequisite: PY 212 or PY 221

A brief review of the development and present status of farm and rural electrification introduces a study of simple but basic electricity and its safe application

through electric equipment and allied utilities to agricultural and farm enterprises. Fundamental farm wiring, circuit design, control and protection are carefully studied. Electric motors, water systems and the design of lighting, heating and ventilation systems for the farm and home are included in the course of study.

BAE 342 AGRICULTURAL PROCESSING
Prerequisites: MA 301, MAE 301

4 (3-2) S

Theory and application of heat and mass transfer to processing of agricultural crops. Topics emphasized will include psychrometrics, thin layer and deep bed drying, continuous-flow drying, and principles of biochemical processing. Problem sessions will demonstrate principles of fluid flow, materials handling, process control and various drying systems.

Messrs. Young, Johnson

BAE 361 ANALYTICAL METHODS
Prerequisite: MA 301
Corequisite: EM 301

3 (2-2) F

A course designed to develop the student's skill in problem solving, ranging from the standard approaches to the mechanical design of machine elements and mechanisms to innovative approaches to the design of whole machines and systems.

Mr. Bowen

BAE 381 AGRICULTURAL STRUCTURES AND ENVIRONMENT
Prerequisites: EM 307, MAE 301

3 (2-2) S

Principles of environmental control and structural analysis are combined with biological principles for the design of agricultural structures. Topics emphasized include physiological reactions of animals, plants and agricultural produce to their environment, applications of heat transfer and psychrometrics in calculating ventilation requirements and heating or cooling loads, structural analysis, material selection, agricultural waste management and economic considerations of various structural alternatives.

Mr. Holmes

BAE 391 ELECTROTECHNOLOGY IN BIOLOGICAL AND AGRICULTURAL ENGINEERING
Prerequisite: EE 331

3 (2-3) F

Basic concept for selecting and utilizing electromagnetic devices are covered in depth. Switching circuits and central circuits are discussed. Transducers and measurement techniques are related to agricultural problems.

Mr. McClure

BAE 411 FARM POWER AND MACHINERY
Prerequisites: BAE 211, PY 211 or PY 221

3 (2-3) S

This course covers the application of heat engineering principles in the development and utilization of power of internal combustion engines, both spark ignition and diesel. Included are thermodynamic principles and a classification of these to the actual design and construction of engines, together with principles of carburetion and ignition. Power transmission units, hydraulics and hydraulic controls are emphasized. Power measurement and testing, and the economic utilization of power units are brought into the context of modern agriculture.

Mr. Fore

BAE 433 CROP PRESERVATION AND PROCESSING
Prerequisite: BAE 341

3 (2-3) F

This course deals with the physical and biochemical characteristics of harvested crops and crop products as they define the requirements for the best preservation of quality. The properties of air-water vapor mixtures, the application of heat to air and crops, the characteristics and use of fans and heaters, the air flow requirements and measurement for crop preservation and materials handling will be studied. Feed preparation, mixing and handling are included in the course.

BAE 451, 452 AGRICULTURAL ENGINEERING DESIGN I AND II**3 (1-6) FS****Prerequisite:** Senior standing in SBE curriculum

Design concepts are applied to current agricultural engineering problems. One major design project is combined with a variety of case studies and short term design problems to develop the students confidence in his ability to do design work.

Mr. Holmes**BAE 461 ANALYSIS OF AGRICULTURAL PRODUCTION SYSTEMS****3 (3-0) F****Prerequisites:** MA 201, EC 205, ST 361

Survey of methods of systems analysis for agricultural engineering students. Intermediate economics analysis, with particular emphasis on farm machinery economics; materials—handling problems; activity network and scheduling problems; techniques of obtaining and processing systems data.

Mr. Sowell**BAE 462 FUNCTIONAL DESIGN OF FIELD MACHINES****3 (2-2) S****Prerequisites:** BAE 361, MAE 301, SSC 200

A study of the modern farm tractor and field machines. The emphasis of the course is on the translation of measurements of biological and physical factors of the agricultural production system into machine specifications that can be effectively converted into production machines by engineers of the manufacturing industry.

Mr. Bowen**BAE 472 AGRICULTURAL WATER MANAGEMENT****4 (3-2) F****Prerequisites:** BS 100, SSC 200

Aspects of hydrology and soil-water-plant relationships as related to agricultural water management. Drainage and irrigation are discussed in depth. Water quality, agricultural related pollution and water laws are discussed.

Mr. Skaggs**FOR GRADUATES AND ADVANCED UNDERGRADUATES****BAE 552 INSTRUMENTATION FOR AGRICULTURAL RESEARCH AND PROCESSING****2 (1-3) S****Prerequisites:** EE 331, MA 301

Theory and application of primary sensing elements and transducers, calibration and use of standards. Use of electronic and solid-state circuits in amplifiers, recorders and controllers. Use of specialized measurement systems for agricultural research and processing including an introduction to correlation and power spectral density measurements.

Mr. Rohrback**BAE 580 ANALYSIS OF THE PHYSICAL PROPERTIES OF BIOMATERIALS****3 (2-2) Alternate S****Prerequisites:** PY 205, PY 208

Physical characteristics—shape and size, volume and density, and surface area—of biomaterials. Aerodynamic and hydrodynamic characteristics (drag coefficient and terminal velocity) and dimensional analysis. Friction (static and rolling), particle mechanics and gravity and forced particle flow. Thermal properties (expansion and conductivity, specific heat), electrical properties (resistance and conductance, dielectric and electrostatic behavior), optical properties using transmittance and reflectance, and x-ray laser.

Mr. Hammerle**BAE 585 Biorheology****3 (2-2) Alternate S****Prerequisites:** PY 205, EM 301

The concepts of strain, stress and the mechanical viscoelastic properties of biological solids, fluids and slurries. The time-dependent deformation and flow of

biomaterials, elements of strength of materials, rheological equations and model concepts, creep-relaxation and dynamic behavior, contact problems and the Boltzman superposition principle as a function of time, temperature and moisture content.
Mr. Hammerle

BAE 590 SPECIAL PROBLEMS

Credits Arranged F S

Prerequisite: Senior or graduate standing in agricultural engineering

Each student will select a subject on which he will do research and write a technical report on his results. He may choose a subject pertaining to his particular interest in any area of study in agricultural engineering.
Staff

FOR GRADUATES ONLY

BAE 654 NONEQUILIBRIUM THERMODYNAMICS IN BIOENGINEERING 3 (3-0) S

BAE 661 ANALYSIS OF FUNCTION AND DESIGN OF
BIOLOGICAL AND PHYSICAL SYSTEMS 3 (2-3) S

BAE 671 (SSC 671) THEORY OF DRAINAGE—SATURATED FLOW 3 (3-0) S

BAE 674 (SSC 674) THEORY OF DRAINAGE—UNSATURATED FLOW 3 (3-0) F

BAE 681 ANALYSIS OF FUNCTION AND DESIGN OF FARMSTEAD SYSTEMS 4 (4-0) F S

BAE 695 SEMINAR 1 (1-0) F S

BAE 699 RESEARCH IN BIOLOGICAL AND AGRICULTURAL
ENGINEERING Credits Arranged

BIOLOGICAL SCIENCES

BS 100 GENERAL BIOLOGY 4 (3-2) F S

Basic principles and concepts of biology, including the structure and function of cells and organisms, the organization and requirements of living systems, development, heredity and evolution.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

BS 500 (HI 500) THE DEVELOPMENT OF CONTEMPORARY CONCEPTS IN
BIOLOGY 3 (3-0) S

Prerequisite: General biology

Selected contemporary concepts of biology are traced from their origins. Considerable attention is given to the lives of the men who have made important contributions to the biological sciences.

FOR GRADUATES ONLY

BS 590 SPECIAL PROBLEMS IN BIOLOGICAL INSTRUMENTATION 1-3 FS

Prerequisite: Consent of instructor

BS 690 SEMINAR IN CELL BIOLOGY

1 (1-0) S

BS 696 TOPICS IN BIOLOGICAL ULTRASTRUCTURE

1 (1-0) F

BIOMATHEMATICS

FOR GRADUATES AND ADVANCED UNDERGRADUATES

BMA 493 SPECIAL TOPICS IN BIOMATHEMATICS

1-3 FS

Prerequisite: Consent of instructor

Directed readings, problem sets, written and oral reports at an introductory level as dictated by need and interest of student; new 400-level courses during the developmental phase.

Staff

BMA 501 THEORETICAL BIOCHEMISTRY I

3 (3-0) F

Prerequisites: MA 405, CH 433, BCH 551 or consent of instructor

Application of physical theory and mathematics to biochemistry. Examination of basic principles of molecular theory, reaction rate theory, statistical mechanics and nonequilibrium thermodynamics as applied to biochemical systems. (Offered fall 1971, and alternate years.)

Mr. Gold

BMA 502 THEORETICAL BIOCHEMISTRY II

3 (3-0) S

Prerequisite: BMA 501

Continuation of BMA 501. Coupling of diffusion and chemical reactions. Mathematical description of enzyme control, coupled sequences of enzyme reactions, feedback loops and oscillatory reactions. Experimentally oriented topics include theory of chemical relaxation and tracer dynamics. (Offered spring 1972, and alternate years.)

Mr. Gold

BMA 571 (MA 571, ST 571) BIOMATHEMATICS I

3 (3-0) F

Prerequisites: Advanced calculus, reasonable background in biology or consent of instructor

The role of theory construction and model building in the development of experimental science. Induction vs. deduction. The historical development of mathematical theories and models for the growth of one-species populations (logistic and off-shoots), including consideration of age distributions (matrix theory, Leslie and Lopez; continuous theory, Lotka). Some of the more elementary theories on the growth of organisms (von Bertalanffy, with applications to ecology; allometric theories, cultures grown in a chemostat). Mathematical theories of two and more species systems (predator-prey, competition, symbiosis; acc. to the Volterra-Lotka schemes, including present-day research), and discussion of some related models for chemical reaction kinetics. Much emphasis is placed on scrutiny of the biological concepts as well as of the mathematical structure of the models in order to uncover both weak and strong points of the models discussed. Mathematical treatment of the differential equations in these models stresses qualitative and geometric aspects.

Mr. van der Vaart

BMA 572 (MA 572, ST 572) BIOMATHEMATICS II

3 (3-0) S

Prerequisites: BMA 571, elementary probability theory

Continuation of topics of BMA 571. Some more advanced mathematical techniques concerning nonlinear differential equations of the types encountered in BMA 571: several concepts of stability, asymptotic directions, periodic models. Comparison of deterministic and stochastic models for several biological pro-

blems, including birth and death processes. Certain aspects of linear system theory (time-invariant and variable models) used for the analysis of biological systems. Discussion of various applications of mathematics to biology, e.g., theories of aging, some recent research. Mr. van der Vaart

BMA 591 SPECIAL TOPICS

Maximum 3

Prerequisite: Consent of instructor

Directed readings, problem sets, written and oral reports as directed by need and interest of the student; new 500-level courses during the developmental phase.

Graduate Staff

FOR GRADUATES ONLY

BMA 691 ADVANCED SPECIAL TOPICS

1-3 F S

BMA 694 SEMINAR

1 (1-0) F S

BMA 699 RESEARCH

Credits Arranged F S

BOTANY

FOR UNDERGRADUATES

BO 200 PLANT LIFE

4 (3-3) F S

A survey of the types of plants and their diversities in structure, life cycle, habitat and economic importance. Messrs. Anderson, Koch, Schlichting

BO 360 (ZO 360) INTRODUCTION TO ECOLOGY

4 (3-3) F S

Prerequisite: BS 100

The study of the relationships between organisms and their environment and of the interaction among organisms. A balanced perspective in the basic principles of ecology and in their importance to man and his environment is presented. Content includes: ecosystems (energy flow and nutrient cycles); pollution; environment-organism interactions; population dynamics; interspecies ecology; communities; world biomes and paleoecology; and applied ecology.

Messrs. Cooper, Seneca, Quay

BO 400 PLANT DIVERSITY

3 (2-3) F

Prerequisite: BO 200 or equivalent

A comprehensive survey of the evolutionary diversity and phylogeny of the plant kingdom. Emphasis is placed on the evolutionary trends and the basis for assumed relationships, considering fossils as well as living forms. Mr. Hardin

BO 403 SYSTEMATIC BOTANY

4 (2-4) S

Prerequisite: BS 100 or BO 200

A systematic survey of vascular plants, emphasizing field identification, terminology and general evolutionary relationships. Mr. Koch

BO 414 (ZO 414) CELL BIOLOGY

4 (3-3) F

(See zoology, page 458.)

BO 421 PLANT PHYSIOLOGY

4 (3-3) S

Prerequisites: BS 100 or BO 200, one year of college chemistry

Physiology of the green plant emphasizing plant organization, water and solute relationships, organic and inorganic nutrition, growth and development.

Messrs. Blum, Noggle, Troyer

FOR GRADUATES AND ADVANCED UNDERGRADUATES**BO 510 PLANT ANATOMY**

4 (2-6) F

Prerequisite: BO 200

A study of the cells, tissues and organs of common flowering plants and gymnosperms. Growth and differentiation patterns will be considered with emphasis on current research. (Offered fall, 1970 and alternate years.)

Mr. Anderson

BO 522 ADVANCED MORPHOLOGY AND PHYLOGENY OF SEED PLANTS

4 (3-3) S

Prerequisite: BO 403

A comprehensive survey of the morphology and evolution of angiosperms and gymnosperms. Special emphasis is given to detailed vegetative and reproductive morphology of fossil and living forms, and to their presumed evolutionary relationships. (Offered spring, 1972 and alternate years.)

Mr. Hardin

BO 524 GRASSES, SEDGES, AND RUSHES

4 (2-6) F

Prerequisite: BO 403

A course dealing with three large, economically and ecologically important plant families. A working familiarity with these three groups will be achieved through an introduction to the special terminology used in dealing with these plants, extensive field work emphasizing keying out plants collected, and a study of the recently developed modern classification of the grasses. (Offered fall, 1971 and alternate years.)

Mr. Koch

BO 544 PLANT GEOGRAPHY

3 (3-0) S

Prerequisites: BO 403, BO 360, GN 411, or equivalents

A course in descriptive and interpretive plant geography, synthesizing data from the fields of ecology, genetics, geography, paleobotany and taxonomy. The course will include a survey of the present distribution of major vegetation types throughout the world, a discussion of the history and development of this present pattern of vegetation, and a discussion of the principles and theories of plant geography. (Offered spring, 1971 and alternate years.)

Mr. Cooper

BO 551 ADVANCED PLANT PHYSIOLOGY I

3 (3-0) F

Prerequisites: General botany or biology, and biochemistry

The first half of a two-semester sequence covering the current status of plant physiology. Topics will include plant organization, metabolism, water relations, solute relations, photobiology and respiration.

Messrs. Noggle, Troyer

BO 552 ADVANCED PLANT PHYSIOLOGY II

3 (3-0) S

Prerequisites: General botany or biology, and biochemistry

The second half of a two-semester sequence covering the current status of plant physiology. Topics will include inorganic nutrition, nitrogen assimilation, plant growth substances, physiology of seeds, vegetative growth, reproductive growth, aging and senescence.

Messrs. Noggle, Troyer

BO 553 LABORATORY IN ADVANCED PLANT PHYSIOLOGY I

1 (0-3) F

Prerequisite or corequisite: BO 551

Laboratory to accompany BO 551. Laboratory procedures in plant nutrition, plant structure and composition, water relations, respiration. Messrs. Noggle, Troyer

BO 554 LABORATORY IN ADVANCED PLANT PHYSIOLOGY II 1 (0-3) S
Prerequisite or corequisite: BO 552

Laboratory to accompany BO 552. Laboratory procedures in enzymes, photosynthesis, photobiology, plant growth substances. Messrs. Noggle, Troyer

BO 560 (ZO 560) PRINCIPLES OF ECOLOGY 4 (3-3) F
(See zoology, page 461.)

BO 574 (MB 574) PHYCOLOGY 3 (1-4) S
Prerequisite: BS 100 or BO 200

An introduction to the classes of algae. The systematic position, life history and ecology of important genera in the local flora, both fresh-water and marine, are emphasized. Mr. Schlichting

BO 575 (MB 575, PP 575) THE FUNGI 3 (3-0) S
Prerequisite: BO 200 or equivalent

An overview of the fungi within the framework of a survey of the major classes. Lectures while covering the major groups systematically will also include ancillary material on such aspects as ultrastructure, environmental adaptations, sexuality, ontogeny and economic, including historical, importance. Mr. Moore

BO 576 (MB 576, PP 576) THE FUNGI—LABORATORY 1 (0-3) S
Corequisite: BO 575

The course will provide illustrative material of the fungal assemblages discussed in BO 575. Mr. Moore

BO 590 TOPICAL PROBLEMS 1-3 F S
Prerequisite: Consent of instructor

Discussions and readings on problems of current interest in the fields of ecology, anatomy and morphology, taxonomy, and cell biology. May be repeated, with change in topic, for a maximum of six credits. Graduate Staff

FOR GRADUATES ONLY

BO 612 PLANT MORPHOGENESIS 4 (3-3) S

BO 620 ADVANCED TAXONOMY 3 (2-2) S

BO 625 (PP 625) ADVANCED MYCOLOGY 4 (2-6) F

BO 631 WATER RELATIONS OF PLANTS 3 (3-0) S

BO 633 PLANT GROWTH AND DEVELOPMENT 3 (3-0) S

BO 634 INTRODUCTION TO THE THERMODYNAMICS OF BIOLOGICAL SYSTEMS 3 (3-0) S

BO 636 DISCUSSIONS IN PLANT PHYSIOLOGY 1 (1-0) F S

BO 660 (ZO 660) ADVANCED TOPICS IN ECOLOGY I 4 (3-3) S

BO 661 (ZO 661) ADVANCED TOPICS IN ECOLOGY II 4 (3-3) S

BO 691 BOTANY SEMINAR 1 (1-0) F S

BO 693 SPECIAL PROBLEMS IN BOTANY

Credits Arranged F S

BO 699 RESEARCH

Credits Arranged F S

CHEMICAL ENGINEERING

FOR UNDERGRADUATES

CHE 205 CHEMICAL PROCESS PRINCIPLES

3 (3-0) F S

Prerequisites: CH 107, MA 201

The primary emphasis of the course is the chemical interactions of matter and the physical interactions of multiphase system. The course introduces engineering methods of treating material balances, stoichiometry, thermophysics, thermochemistry and first law thermodynamics.

Mr. Hopfenberg

CHE 225 CHEMICAL PROCESS SYSTEMS

3 (2-2) S

Prerequisite: PY 208

Corequisite: MA 301

Physical measurement of importance in chemical engineering. Temperature, pressure, pH, concentration, etc. including dynamic response of measuring elements. Control element, electronic, pneumatic, etc. Introduction to Process Control.

Mr. Martin

CHE 301, 302 ELEMENTS OF CHEMICAL ENGINEERING

3 (3-0) F S

An introduction to principles of chemical engineering including calculations involved in industrial processes and equipment. The course is designed for students not majoring in chemical engineering.

Mr. Bright

CHE 307 INTRODUCTORY CHEMICAL ENGINEERING

3 (3-0) F S

Prerequisite: CHE 205

Basic principles of fluid flow, heat transfer and mass transfer with emphasis on application to design of chemical processes and equipment.

Mr. Bright

CHE 311 TRANSPORT PROCESSES I

3 (2-2) F S

Prerequisites: MA 301, PY 208, CHE 205

An introduction to momentum, heat and mass transport processes, with emphasis on chemical engineering. Problems in fluid dynamics and heat transfer.

Mr. Rousseau

CHE 315 CHEMICAL PROCESS THERMODYNAMICS

3 (3-0) S

Prerequisites: CH 431, CHE 205, MA 301

A study of the laws of thermodynamics and their application to chemical engineering problems, both in theory and in practice. Criteria of equilibrium in physical and chemical changes. Behavior of real fluids, including mixtures.

Mr. Beatty

CHE 316 THERMODYNAMICS OF CHEMICAL AND PHASE EQUILIBRIA

3 (3-0) S

Prerequisite: CHE 315

Thermodynamics is the principal tool for systematic study of chemical reaction equilibria and phase equilibrium. The concepts of fugacity, activity and chemical potential as methods, for predicting the effect of temperature, pressure, etc. on equilibrium compositions will be studied in considerable detail. Methods for measuring and estimating thermodynamics properties important to equilibrium calculation in real systems will be included.

Mr. Beatty

- CHE 325 INTRODUCTION TO PLASTICS** 3 (3-0) F S
Prerequisite: CH 103
A general survey of plastics and polymers. Emphasis is on types, applications, fabrication, processing and testing. Mr. Seely
- CHE 327 SEPARATION PROCESSES I** 3 (3-0) S
Prerequisite: CHE 311
An application of the principles of transport phenomena to the unit operations of absorption, extraction, distillation, drying, filtration, etc. with emphasis on design procedures and economic consideration. Mr. Schoenborn
- CHE 412 TRANSPORT PROCESSES II** 3 (3-0) S
Prerequisite: CHE 327
An intensive study of momentum, heat and mass transport processes, with emphasis on chemical engineering. Problems in fluid, heat and mass transfer. Mr. Ferrell
- CHE 425 PROCESS MEASUREMENT AND CONTROL I** 3 (2-2) F
Prerequisites: CHE 225, CHE 327
A study of the continuous control of typical chemical engineering processes including the techniques of feedback, cascade, feedforward and interacting systems. Dynamics, stability and control of heat exchangers, flow systems, distillation columns and chemical reactors are illustrated. Mr. Martin
- CHE 426 PROCESS MEASUREMENT AND CONTROL II** 3 (2-2) S
Prerequisite: CHE 425 or EE 435 or MAE 435
An extension of the theory and application of process control techniques to the analysis of physical systems. This course covers sampled data and nonlinear systems and includes an introduction to optimum control techniques and adaptive control. Mr. Martin
- CHE 428 SEPARATION PROCESSES II** 3 (3-0) S
Prerequisite: CHE 327
An intensive study of the principles (diffusion and interphase mass transfer) underlying such unit operations as distillation, drying, absorption, etc., with emphasis on procedures and economic problem. Mr. Schoenborn
- CHE 431 CHEMICAL ENGINEERING LABORATORY I** 3 (1-5) S
Prerequisite: CHE 311
Laboratory work on typical apparatus involving unit operations. Experiments are designed to augment the theory and data of lecture courses and to develop proficiency in the writing of technical reports. Mr. Seely
- CHE 432 CHEMICAL ENGINEERING LABORATORY II** 3 (1-5) F
Prerequisite: CHE 431
A continuation of CHE 431. This course will consist of a small number of group projects in research, design or development. Mr. Seely
- CHE 446 CHEMICAL PROCESS KINETICS** 3 (3-0) F
Prerequisite: CHE 315
A basic study of homogenous and heterogeneous chemical reactions, and of catalysis. Mr. Stahel
- CHE 451 CHEMICAL ENGINEERING DESIGN** 3 (2-2) F S
Prerequisites: CHE 315, CHE 327, CHE 432
A general treatment of chemical process design and optimization. The interplay of economic and technical factors in process development, site selection, project

design, construction and production management. Applications of cost accounting, cost estimation for new equipment, measures of profitability. Case studies, readings, design problems and reports. Mr. Marsland

CHE 495 SEMINAR IN CHEMICAL ENGINEERING 1 (1-0) F S
Professional aspects of chemical engineering; topics of current interest in chemical engineering. Staff

CHE 497 CHEMICAL ENGINEERING PROJECTS 1-3 F S
Introduction to research through experimental, theoretical and literature studies of chemical engineering problems. Oral and written presentation of reports. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

CHE 501 APPLICATIONS OF STRUCTURE—PROPERTY RELATIONSHIPS OF CHEMICAL ENGINEERING MATERIALS 3 (3-0) F
Prerequisites: CHE 315, CH 431, CH 223

A survey of the relationship between molecular structure and bulk properties of nonmetallic materials as applied in chemical engineering processes. Special attention will be directed at the application of surface and colloid chemistry as well as polymer science. Mr. Hopfenberg

CHE 511 PROBLEM ANALYSIS FOR CHEMICAL ENGINEERS 3 (3-0) S
Prerequisites: CHE 428, MA 301

The application of the methods of mathematical analysis to the formulation and solution of problems in transport phenomena, transient phenomena in unit operations, process dynamics and thermodynamics. Study and use of analog computer solutions of these problems. Mr. Ferrell

CHE 513 THERMODYNAMICS I 3 (3-0) F
Prerequisite: CHE 315

An intermediate course in thermodynamic principles and their application to chemical and phase equilibria. The course is largely from a macroscopic viewpoint but consideration will be given to some aspects of the statistical viewpoint. Mr. Beatty

CHE 515 TRANSPORT PHENOMENA 3 (3-0) S
Prerequisite: CHE 327

A theoretical study of transport of momentum, energy and matter with emphasis on the latter two. The diffusional operations, including coupled heat and mass transfer, are introduced in the light of the theory. Mr. Marsland

CHE 517 KINETICS AND CATALYSIS 3 (3-0) F
Prerequisite: CHE 446

An intensive study of homogeneous and heterogeneous kinetic reactions. Emphasis will be placed on fundamental approaches, experimental methods and mathematical techniques in engineering analysis of chemical reaction systems. Mr. Stahel

CHE 527 (OR 527) OPTIMIZATION OF ENGINEERING PROCESSES 3 (3-0) F
Prerequisites: MA 511, CSC 111 or equivalent

Mathematical methods for the optimization of engineering processes are developed, and illustrative applications of these methods are presented and discussed. Specific topics covered are drawn from a list which includes mathematical programming, geometric programming, sensitivity analysis, direct search and elimination techniques, variational techniques and the minimum principle, quasilinearization

and dynamic programming. The emphasis throughout the course is on applications of the techniques discussed rather than fully rigorous development of the theory.

Mr. Felder

CHE 540 ELECTROCHEMICAL ENGINEERING 3 (3-0) S

Prerequisite: Physical chemistry

The application of electrochemical principles to such topics as electrolysis, electroanalysis, electroplating, metal refining, etc.

Mr. Schoenborn

CHE 541 CELLULOSE INDUSTRIES 3 (3-0) FS

Prerequisite: Organic chemistry

Methods of manufacture and application of cellulose chemical conversion products. Emphasis is placed on recent developments in the field of synthetic fibers, films, lacquers and other cellulose compounds.

Mr. Seely

CHE 543 TECHNOLOGY OF PLASTICS 3 (3-0) S

Prerequisite: Organic chemistry

The properties, methods of manufacture and applications of synthetic resins. Recent developments in the field are stressed.

Mr. Schoenborn

CHE 597 CHEMICAL ENGINEERING PROJECTS 1-3

Prerequisite: Graduate standing

A laboratory study of some phase of chemical engineering or allied field. Staff

CHE 598 SPECIAL TOPICS IN CHEMICAL ENGINEERING 1-3

Prerequisite: Graduate standing

FOR GRADUATES ONLY

CHE 610 HEAT TRANSFER 3 (3-0) F

CHE 621 MASS-TRANSFER OPERATIONS II 3 (3-0) F

CHE 622 CHEMICAL REACTION ENGINEERING 3 (3-0) S

CHE 623 FLUID AND PARTICLE DYNAMICS 3 (3-0) S

CHE 624 PROCESS DYNAMICS 3 (3-0) F

CHE 625 THERMODYNAMICS II 3 (3-0) F

CHE 631 CHEMICAL PROCESS DESIGN 3 (3-0) S

CHE 671 (TC 671) SPECIAL TOPICS IN POLYMER SCIENCE 1-3 F

CHE 690 READINGS IN CHEMICAL ENGINEERING Credits Arranged

CHE 693 ADVANCED TOPICS IN CHEMICAL ENGINEERING 1-3

CHEMISTRY

FOR UNDERGRADUATES

CH 101 GENERAL CHEMISTRY I 4 (3-3) F S

Fundamental concepts in chemistry, including atomic and molecular structure, states of aggregation of matter, chemical reactions and stoichiometry. Should be followed by CH 103, CH 105 or CH 107.

CH 103 GENERAL CHEMISTRY II 4 (3-3) F S

Prerequisite: CH 101

A continuation of CH 101, designed as a terminal course in chemistry and for students in curricula which do not require full-year chemistry courses beyond the freshman level. The major part of the course is devoted to descriptive inorganic, organic and nuclear chemistry.

CH 104 EXPERIMENTAL CHEMISTRY 1 (0-3) F S

Corequisite: CH 105

A laboratory course to supplement the lecture course CH 105. Required for students who take CH 105 and who intend to take additional chemistry courses.

CH 105 CHEMISTRY—PRINCIPLES AND APPLICATIONS 3 (3-0) F S

Prerequisite: CH 101

A continuation of CH 101, intended primarily for engineering students, with emphasis on introductory chemical thermodynamics, equilibrium, electrochemistry, chemical kinetics, and the application of basic chemical principles to the treatment of organic and inorganic systems. CH 105 will serve as a prerequisite for additional chemistry courses only if accompanied by CH 104.

CH 106 LABORATORY TECHNIQUES I 1 (0-3) F

Corequisite: CH 101

Laboratory work to supplement the laboratory of CH 101.

CH 107 PRINCIPLES OF CHEMISTRY 4 (3-3) F S

Prerequisite: CH 101 with a grade of C or better

A continuation of CH 101, designed for students who plan to take full-year courses in advanced chemistry and for any qualified student desiring a more quantitative course than CH 103. The major part of the course is devoted to the detailed quantitative aspects of stoichiometry, kinetics, equilibrium and electrochemistry, and the treatment of chemical reactions in terms of acid-base concepts.

CH 108 LABORATORY TECHNIQUES II 1 (0-3) S

Corequisite: CH 107

Laboratory work to supplement the laboratory of CH 107, including some elementary quantitative analysis and inorganic preparations.

CH 111 FOUNDATIONS OF CHEMISTRY 5 (5-0) F S

A one-semester course in general chemistry designed primarily for students in liberal arts. Topics include atomic and molecular structure, periodic classification,

gas laws, chemical equilibrium, and elementary descriptive inorganic and organic chemistry.

CH 220 INTRODUCTORY ORGANIC CHEMISTRY 4 (3-3) F S

Prerequisites: CH 103 or CH 107, or CH 104 and CH 105

An introduction to the fundamental principles of organic chemistry included in the study of the hydrocarbons, alcohols, ethers, aldehydes, ketones, acids and their derivatives, esters, phenols, fats, carbohydrates, amino acids, proteins and a selected group of natural and synthetic products.

CH 221 ORGANIC CHEMISTRY I 4 (3-3) F S

Prerequisite: CH 107

CH 221 and CH 223 cover the fundamentals of organic chemistry, including both aliphatic and aromatic compounds.

CH 223 ORGANIC CHEMISTRY II 4 (3-3) F S

Prerequisite: CH 221

A continuation of CH 221.

CH 315 QUANTITATIVE ANALYSIS 4 (3-3) F S

Prerequisites: CH 103 or CH 107, or CH 104 and CH 105

A one-semester course in volumetric and gravimetric analysis including techniques, stoichiometry and principles of neutralization, oxidation-reduction and precipitation methods.

CH 331 INTRODUCTORY PHYSICAL CHEMISTRY 4 (3-3) F S

Prerequisites: CH 103 or CH 107, or CH 104 and CH 105; MA 102 or MA 112

Designed for students whose background in mathematics and physics is not sufficient to meet the requirements of CH 431, CH 433, but who desire instruction on chemical principles in addition to that provided at the freshman level.

CH 401 SYSTEMATIC INORGANIC CHEMISTRY 3 (3-0) S

Corequisite: CH 433

A survey of the chemical elements based on atomic structure and the periodic system, also introducing newer concepts of structure and symmetry. A knowledge of basic physical chemical principles is prerequisite.

CH 411 ANALYTICAL CHEMISTRY I 4 (2-6) F

Prerequisites: CH 431, CH 432

Corequisite: CH 433

An introduction to analytical chemistry, including the design, execution and interpretation of quantitative chemical measurements. Chromatographic, gravimetric and related techniques of separation are presented.

CH 413 ANALYTICAL CHEMISTRY II 4 (2-6) S

Prerequisite: CH 411

Methods of quantitative analysis based on solution chemistry, electrochemistry and the interactions of radiation with matter. Specific topics include acid-base, potentiometric, and coulometric titrations, and absorption spectroscopy.

CH 428 QUALITATIVE ORGANIC ANALYSIS 3 (1-6) F

Prerequisite: CH 223

An introduction to the identification of organic compounds by means of physical properties (including infrared spectra), chemical classification tests and preparation of derivatives.

- CH 431 PHYSICAL CHEMISTRY I 3 (3-0) F S
Prerequisites: CH 107, MA 202, PY 207 or PY 208
Corequisite: MA 301
CH 431, CH 433 and CH 435 provide an intensive study of physical chemical principles. CH 431 emphasizes states of matter, thermodynamics, and physical and chemical equilibrium.
- CH 432 PHYSICAL CHEMISTRY I LABORATORY 1 (0-3) F
Corequisite: CH 431
Laboratory course to accompany the lecture work in CH 431.
- CH 433 PHYSICAL CHEMISTRY II 3 (3-0) F S
Prerequisites: CH 431, MA 301
A continuation of CH 431, emphasizing properties of solutions, electrochemistry and reaction kinetics.
- CH 434 PHYSICAL CHEMISTRY II LABORATORY 1 (0-3) S
Corequisite: CH 433
Laboratory course to accompany the lecture work in CH 433.
- CH 435 PHYSICAL CHEMISTRY III 3 (3-0) F
Prerequisites: CH 431, MA 301
A continuation of CH 431, emphasizing molecular structure and chemical bonding.
- CH 441 COLLOID CHEMISTRY 3 (2-3) S
Prerequisites: CH 220, CH 315
Adsorption, preparation, properties, constitution, stability and application of sols, gels, emulsions, foams and aerosols; dialysis; Donnan membrane equilibrium. (Offered spring 1971 and alternate years.)
- CH 461 (TC 461) CHEMISTRY OF FIBERS 3 (3-0)
(See textile chemistry, page 445.)
- CH 490 CHEMICAL PREPARATIONS 3 (1-6) F S
Prerequisite: Three years of chemistry
Lectures and laboratory work in preparative chemistry. Synthetic procedures will be selected to illustrate advanced methods and techniques in both inorganic and organic chemistry.
- CH 491 READING IN HONORS CHEMISTRY 2-6 F S
Prerequisite: Three years of chemistry
A reading course for exceptionally able students at the senior level. The students will do extensive reading in areas of advanced chemistry and will present written reports of their findings.
- CH 493 CHEMICAL LITERATURE 1 (1-0) F
Prerequisite: Three years of chemistry
A systematic introduction to the location and retrieval of information required for the solution of chemical problems.
- CH 499 SENIOR RESEARCH IN CHEMISTRY 1-3 F S
Prerequisite: Three years of chemistry
An introduction to research. Independent investigation of a research problem under the supervision of a member of the chemistry faculty.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

CH 501 INORGANIC CHEMISTRY I

3 (3-0) F

Prerequisite: CH 433

Modern inorganic chemistry from the point of view of the chemical bond. Chemical periodicity and its origins in atomic structure, the ionic bond and electronegativity, crystal structure and bonding in ionic solids, the metallic state, conduction and semiconductors, and the preparation and properties of illustrative compounds.

CH 503 INORGANIC CHEMISTRY II

3 (3-0) S

Prerequisite: CH 501

The hydrogen molecule-ion and the theory of the covalent bond, molecular orbitals and hybridization, dipole moments and magnetic properties, the theory of acids and bases, nonaqueous solvents, coordination compounds, carbonyl and quasiaromatic compounds, and the chemistry of the transition metals, lanthanides and actinides.

CH 511 CHEMICAL SPECTROSCOPY

3 (3-0) F

Prerequisite: CH 433

Theory, analytical applications and interpretation of spectra as applied to chemical problems. Major emphasis will be placed upon ultraviolet, visible and infrared spectra.

CH 515 CHEMICAL INSTRUMENTATION

3 (3-0) S

Prerequisite: CH 431

Corequisite: CH 411

Basic electronic components and circuits, the response of laboratory instruments, design and modification of typical electronic control and measurement systems. Emphasis will be placed on the transducers and control elements utilized in chemical research. (Offered spring, 1972 and alternate years.)

CH 521 ADVANCED ORGANIC CHEMISTRY I

3 (3-0) F

Prerequisites: CH 223, CH 433 or CH 435

Structure, stereochemistry and reactions of the various classes of hydrocarbons. The molecular orbital treatment of bonding and reactivity of alkenes, the conformational interpretation of cycloalkane and cycloalkene reactivity, and the application of optical isomerism to the study of reaction mechanisms will be emphasized.

CH 523 ADVANCED ORGANIC CHEMISTRY II

3 (3-0) S

Prerequisite: CH 521

An introduction to acid-base theory and mechanistic organic chemistry as applied to synthetically useful organic reactions.

CH 525 PHYSICAL METHODS IN ORGANIC CHEMISTRY

3 (3-0) S

Prerequisites: CH 223, CH 433 or CH 435

Application of physical methods to the solutions of structural problems in organic chemistry. Emphasis will be on spectral methods including infrared, ultraviolet, nuclear magnetic resonance, mass spectrometry, electron paramagnetic resonance, x-ray and electron diffraction, and optical rotatory dispersion.

CH 531 CHEMICAL THERMODYNAMICS

3 (3-0) F

Prerequisites: CH 433, MA 301

An extension of elementary principles to the treatment of ideal and real gases, ideal solutions, electrolytic solutions, galvanic cells, surface systems, and irre-

versible processes. An introduction to statistical thermodynamics and the estimation of thermodynamic functions from spectroscopic data.

CH 533 CHEMICAL KINETICS 3 (3-0) S

Prerequisites: CH 433, MA 301

An intensive survey of the basic principles of chemical kinetics with emphasis on experimental and mathematical techniques, elements of the kinetic theory, and theory of the transition state. Applications to gas reactions, reactions in solution, and mechanism studies.

CH 535 SURFACE PHENOMENA 3 (3-0) S

Prerequisites: CH 433, MA 301

An intensive survey of the topics of current interest in surface phenomena. Formulations of basic theories are presented together with illustrations of their current applications. (Offered spring, 1972 and alternate years.)

CH 537 QUANTUM CHEMISTRY 3 (3-0) S

Prerequisites: MA 301, CH 433 or PY 407

The elements of wave mechanics applied to stationary energy states and time dependent phenomena. Applications of quantum theory to chemistry, particularly chemical bonds.

CH 545 RADIOCHEMISTRY 3 (2-3) S

Prerequisite: PY 410

The applications of radioactivity to chemistry and the applications of chemistry to the radioactive elements, particularly the transuranium elements and fission products.

CH 562 (TC 562) PHYSICAL CHEMISTRY OF HIGH POLYMERS—BULK PROPERTIES 3 (3-0) S

(See textile chemistry, page 445.)

FOR GRADUATES ONLY

CH 623 VALENCE AND THE STRUCTURE OF ORGANIC MOLECULES 3 (3-0) F

CH 625 ORGANIC REACTION MECHANISMS 3 (3-0) S

CH 627 CHEMISTRY OF METAL—ORGANIC COMPOUNDS 3 (3-0) F

CH 631 CHEMICAL THERMODYNAMICS II 3 (3-0) S

CH 659 (BCH 659) NATURAL PRODUCTS 3 (3-0) F

CH 691 SEMINAR 1 (1-0) F S

CH 693 ADVANCED TOPICS IN PHYSICAL CHEMISTRY 3 (3-0) F S

CH 695 SPECIAL TOPICS IN CHEMISTRY Maximum 3 F S

CH 699 CHEMICAL RESEARCH Credits Arranged F S

CIVIL ENGINEERING

FOR UNDERGRADUATES

CE 201 ENGINEERING MEASUREMENTS IN SURVEYING

3 (2-3) F S

Prerequisite: MA 201

Not for civil engineering or civil engineering-construction option students.

The general theory of engineering measurement, errors, significant figures, repeated observations, precision ratios and accuracy of measurements are presented. Other lecture topics include horizontal and vertical control, stadia theory, concepts of area measurements, elements of simple curves, photogrammetry and introduction to machine computation.

CE 202 INTRODUCTION TO CIVIL ENGINEERING

2 (1-3) F

Prerequisite: MA 201

An introduction to civil engineering through the use of computers to solve typical problems in each subject area.

CE 301 ENGINEERING SURVEYING

3 (2-3) F

Prerequisite: CE 202

The principles and applications of engineering surveying in solving civil engineering problems in planning, design and construction; including horizontal and vertical control; topographic maps, photogrammetry and elements of geodesy. (Not available until fall, 1971.)

CE 305 TRANSPORTATION ENGINEERING I

4 (3-2) S

Prerequisite: CE 301

An integrated approach to the planning, design and operation of transportation systems. Engineering and economic aspects of the basic transport modes, including highway, rail, water and air facilities, are investigated from the viewpoint of the civil engineer. (Not available until spring, 1972.)

CE 324 STRUCTURAL ANALYSIS I

3 (2-3) S

Prerequisite: EM 200

Corequisite: EM 301

Stress analysis of statically determinate beams and framed structures under fixed and moving loads; influence line treatment for moving loads; analysis of displacements; energy principles. (Not available after spring, 1971.)

CE 325 STRUCTURAL ANALYSIS

3 (2-3) F

Prerequisite: EM 301

Stress analysis of statically determinate beams and framed structures under fixed and moving loads; analysis of displacements by methods of conjugate beam and virtual work; indeterminate structural analysis of both rigid frames and trusses by virtual work and by stiffness method. (Not available until fall, 1971.)

CE 326 STRUCTURAL ENGINEERING I

4 (3-3) S

Prerequisite: CE 325

Fundamental principles of elastic, inelastic and ultimate strength analysis and proportioning of structural members in metal, concrete and timber. (Not available until spring, 1972.)

CE 332 MATERIALS OF CONSTRUCTION

3 (2-3) F

Prerequisite: MAT 200

Manufacture and properties of calcareous and bituminous cements and mineral

aggregates. Mechanical properties of the following structural materials: Portland cement concrete, bituminous concrete, masonry materials and timber. Materials testing for research.

CE 338 STRUCTURES I 4 (3-3) F
Prerequisite: EM 211

Analysis of simple structures, reactions, shear and moment diagrams; stress in members of framed structures, graphic states.

CE 339 STRUCTURES II 4 (3-3) S
Prerequisites: CE 338, EM 212

Analysis of indeterminate structures; slopes and deflections; analysis of indeterminate frames by moment distribution.

CE 342 SOIL MECHANICS 4 (3-2) S
Prerequisite: EM 301
Corequisite: CE 331

An introduction to the engineering behavior of soils. A study of physical and mechanical properties of soils, identification and classification, fundamental stress relations, ground water hydraulics, compressibility, shear strength, earth pressure theories, slope stability and bearing capacity. Laboratory periods divided among soil testing, recitation and problem solving. (To be revised as Soil Engineering I in spring, 1972.)

CE 362 ESTIMATES AND COSTS II 3 (2-3) S
Prerequisite: CE 361

Preparation of complete cost estimates of construction projects; bidding procedures and preparation of bids. (Not available after spring, 1971.)

CE 365 CONSTRUCTION ENGINEERING I 4 (3-3) S
Corequisite: CE 326

A construction operations course with emphasis on the organization of the construction industry; construction methods, equipment, productivity and safety; project planning, scheduling and control. (Not available until spring, 1972.)

CE 382 HYDRAULICS 3 (3-0) FS
Prerequisite: EM 303

Properties of fluids and mechanics of fluid flow in pipes and open channels; theory of design and characteristics of pumps and hydraulic motors; measurement of fluid flow. (To be revised in fall, 1971.)

CE 383 WATER RESOURCES ENGINEERING I 4 (3-3) S
Prerequisite: CE 382

The study of the application of natural science, physics and chemistry in the engineering or urban water and waste systems. Case studies are utilized to illustrate the applications and the relationship of these systems to the management of environmental quality in urban areas. (Not available until spring, 1972.)

CE 405 TRANSPORTATION ENGINEERING I 4 (3-2) F
Prerequisite: CE 201

An integrated approach to the planning, design and operation of transportation systems. Engineering and economic aspects of the basic transport modes, including highway, rail, water and air facilities, are investigated from the viewpoint of the civil engineer. (Not available after fall, 1971.)

- CE 406 TRANSPORTATION ENGINEERING II** 4 (3-2) S
 Prerequisite: CE 342
 Continuation of CE 405. (To be revised in fall, 1972.)
- CE 421 STRUCTURAL DESIGN I** 3 (2-3) F
 Prerequisites: CE 324, EM 301
 An introduction to basic concepts of structural design. Elastic and inelastic analysis and design of structural members and connections in metal. Application of the principles in a design project of metal structure. (Not available after spring, 1972.)
- CE 422 STRUCTURAL DESIGN IIA** 3 (2-3) S
 Prerequisites: CE 332, CE 421, CE 425
 Principles of design and analysis of reinforced concrete members with emphasis on the ultimate strength theory. Application of the principles in a design project of a reinforced concrete structure. (Not available after spring, 1973.)
- CE 425 STRUCTURAL ANALYSIS II** 3 (2-3) F
 Prerequisites: CE 324, EM 301
 A treatment of classical theories of indeterminate structural analysis with an introduction to relaxation and matrix methods, and nonlinear analysis. (Not available after spring, 1972.)
- CE 427 STRUCTURAL ENGINEERING II** 3 (2-3) F
 Prerequisite: CE 326
 Basic concepts of structural design. Criteria for safety and serviceability. Structural connections. Analysis and design of complete structural systems. (Not available until fall, 1972.)
- CE 429 STRUCTURAL DESIGN IIB** 3 (2-3) S
 Prerequisites: CE 332, CE 421
 Principles of structural design in reinforced concrete and timber with application to a design project including construction falsework. (Not available after spring, 1972.)
- CE 443 FOUNDATIONS** 3 (3-0) S
 Corequisite: CE 422 or CE 429
 Identification and classification of soils, geological aspects of foundation engineering; methods of investigating subsoil conditions; control of water; types of foundations; legal aspects of foundation engineering. (To be revised as Soil Engineering II in fall, 1972.)
- CE 450 CIVIL ENGINEERING DESIGN** 3 (1-6) S
 Prerequisites: CE 406, CE 427, CE 443 or CE 484
 An integrated team approach is used to a major civil engineering project involving planning, design and analysis under realistic conditions including consideration of environmental factors. (Not available until spring, 1973.)
- CE 460 CONSTRUCTION ENGINEERING PROJECT** 3 (2-3) S
 Prerequisites: CE 463, CE 466
 A study of the planning, design, construction and management of a construction project. (Not available until spring, 1973.)
- CE 461 PROJECT PLANNING AND CONTROL I** 3 (2-3) F
 Prerequisite: CE 362
 Project costs and estimates; analysis of construction plant layout requirements and performance characteristics of equipment. (Not available after fall, 1971.)

CE 462 PROJECT PLANNING AND CONTROL II 3 (2-3) S
Prerequisite: CE 461

Scheduling, analysis and control of construction projects, including critical path techniques. (Not available after spring, 1972.)

CE 463 COST ANALYSIS AND CONTROL 3 (2-3) F
Prerequisite: CE 365

Principles of cost engineering, project estimating, bid procedures, construction cost analysis and control. (Not available until fall, 1972.)

CE 464 LEGAL ASPECTS OF CONTRACTING 3 (3-0) S
Prerequisite: Senior standing

Legal aspects of construction contract documents and specifications; owner-engineer-contractor relationships and responsibilities; bids and contract performance; labor laws.

CE 466 CONSTRUCTION ENGINEERING II 3 (2-3) F
Prerequisites: CE 326, CE 365

An introduction to construction of building systems, with emphasis on the planning, analysis, design and construction of structural subsystems. (Not available until fall, 1972.)

CE 483 WATER RESOURCES ENGINEERING I 3 (3-0) F
Prerequisite: CE 382

The hydrological cycle is studied with particular emphasis on those phases that are of engineering significance. The occurrence and distribution of water; rainfall, runoff, ground water. The development and control of water resources. (Not available after fall, 1971.)

CE 484 WATER RESOURCES ENGINEERING II 3 (3-0) S
Prerequisite: CE 383

The study of the occurrence, flow and control of natural and impounded waters. Case studies of storm drainage, flood control and stream sanitation are utilized to illustrate the use of these principles in the management of river basin water resources. (Not available until fall, 1972.)

CE 485 APPLIED HYDRAULICS 3 (3-0) F
Prerequisite: EM 303

Elements of fluid mechanics, hydraulics and hydrology, with application to problems in construction engineering. (Not available after fall, 1971.)

CE 487 (OY 487, MAS 487) PHYSICAL OCEANOGRAPHY 3 (3-0) S
(See physical oceanography, page 402.)

CE 498 SPECIAL PROBLEMS IN CIVIL ENGINEERING 1-3 FS
Prerequisite: Senior standing in CE or CEC

Study and investigation of special problems in some phase of civil engineering. The course may consist of directed reading in the literature of civil engineering, introduction to research methodology, seminar discussions, dealing with special civil engineering topics of current interest.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

CE 507 AIRPHOTO ANALYSIS I 3 (2-3) FS
Prerequisite: Junior standing

Principles and concepts for engineering evaluation of aerial photographs, including analysis of soils and surface drainage characteristics.

- CE 508 AIRPHOTO ANALYSIS II** 3 (2-3) S
 Prerequisite: CE 507
 Continuation of CE 507 with applications to highway and airport projects.
- CE 509 PHOTOGRAMMETRY** 3 (2-3) F
 Prerequisite: CE 201
 Elements of aerial photogrammetry as applied to civil engineering, surveying and mapping, geometry of aerial photographs, flight planning for aerial photography and stereoscopic plotter instruments, especially the Kelsh Plotter.
- CE 514 MUNICIPAL ENGINEERING PROJECTS** 3 (2-3) S
 Prerequisite: Senior standing in CE
 Special problems relating to public works, public utilities, urban planning and city engineering.
- CE 515 TRANSPORTATION OPERATIONS** 3 (3-0) F
 Prerequisite: CE 406
 The analysis of traffic and transportation engineering operations.
- CE 516 TRANSPORTATION DESIGN** 3 (2-3) S
 Prerequisite: CE 406
 The geometric elements of traffic and transportation engineering design.
- CE 517 WATER TRANSPORTATION** 3 (3-0) F
 Prerequisite: CE 405
 The planning, design, construction and operation of waterways, ports, harbors and related facilities. Development of analytical techniques for evaluating the feasibility of piers, ports and multipurpose river basin projects. The design of marine structures and civil works that are significant in civil engineering, including locks, dams, harbors, ports and contractive and protective works.
- CE 524 ANALYSIS AND DESIGN OF MASONRY STRUCTURES** 3 (3-0) F
 Corequisite: CE 425
 Theory and design of masonry arches, culverts, dams, foundations and masonry walls subjected to lateral loads.
- CE 525, 526 ADVANCED STRUCTURAL ANALYSIS I, II** 3 (3-0) FS
 Prerequisite: CE 425
 A study in depth of classical structural theories, including generalized stiffness and flexibility methods. Treatment of secondary stresses and highrise structures.
- CE 527 NUMERICAL METHODS IN STRUCTURAL ANALYSIS** 3 (3-0) F
 Prerequisite: CE 425
 Numerical solution of problems in structural mechanics, including matrix operations, relaxation, iteration, numerical integration, finite difference and finite element methods.
- CE 531 EXPERIMENTAL STRESS ANALYSIS** 3 (2-3) F
 Prerequisite: CE 425
 Theoretical and experimental techniques for the analysis of strain and stress including mechanical and electrical strain gages, brittle coating, grid method and an introduction to photoelasticity. Structural analysis by indirect and direct models.
- CE 534 PLASTIC ANALYSIS AND DESIGN** 3 (3-0) S
 Prerequisite: CE 421
 Theory of plastic behavior of steel structures; concept of design for ultimate load

and the use of load factors. Analysis and design of components of steel frames including bracings and connections.

CE 536 THEORY AND DESIGN OF PRESTRESSED CONCRETE 3 (3-0) F
Prerequisite: CE 422

The principles and concepts of design in prestressed concrete including elastic and ultimate strength analyses for flexural, shear, bond and deflection. Principles of concordancy and linear transformation for indeterminate prestressed structures. Application of prestressing to tanks and shells.

CE 541 (MAS 541, OY 541) GRAVITY WAVE THEORY I 3 (3-0) F
(See marine sciences, page 358.)

CE 544 FOUNDATION ENGINEERING 3 (3-0) S
Prerequisite: CE 342

Subsoil investigations; excavations; design of sheeting and bracing systems; control of water; footing, grillage and pile foundations; caisson and cofferdam methods of construction.

CE 547 FUNDAMENTALS OF SOIL MECHANICS 3 (3-0) FS
Prerequisite: EM 301

Physical and mechanical properties of soils governing their use for engineering purposes; stress relations and applications to a variety of fundamental problems.

CE 548 ENGINEERING PROPERTIES OF SOILS I 3 (2-3) F
Prerequisite: CE 342

The study of soil properties that are significant in earthwork engineering, including properties of soil solids, basic physiochemical concepts, classification, identification, plasticity, permeability, capillarity and stabilization. Laboratory work includes classification, permeability and compaction tests.

CE 549 ENGINEERING PROPERTIES OF SOILS II 3 (2-3) S
Prerequisite: CE 548

Continuation of CE 548, including the study of compressibility, stress-strain relations and shear strength theories for soil. Laboratory work includes consolidation and shear strength tests.

CE 551 THEORY OF CONCRETE MIXTURES 3 (3-0) F
Prerequisite: CE 332

Course work consists of study in depth of the theory of portland cement concrete mixtures including technology development and published research. Study includes types and properties of portland and special cements including chemical reactions; brief examination of history of mixture design; detailed study of current design methods including water-cement ratio, fineness modulus, B/Bo, American Concrete Institute, and Portland Cement Association procedures; properties of fresh and hardened concretes; strength-age-curing relationships, durability; admixtures; special concretes; production; and quality control.

CE 553 ASPHALT AND BITUMINOUS MATERIALS 3 (2-3) F
Prerequisite: CE 332

Course work consists of study in depth of properties of asphalts and tars for use in waterproofing and bituminous materials and study of the theories of design of bituminous mixtures for construction and paving uses. Study includes types and properties of asphalt cements, cutbacks, emulsions, blown asphalts and tars; brief examination of historical developments; detailed study of bituminous mixture design; properties of bituminous mixtures; and current research. Laboratory work

includes standard tests on asphalts, tars and road oils; design, manufacture and testing of trial batches; and current research techniques.

CE 570 (MB 570) SANITARY MICROBIOLOGY

3 (2-3) S

Prerequisite: MB 401 or equivalent

Fundamental aspects of microbiology and biochemistry are presented and related to problems of stream pollution, refuse disposal and biological treatment. Laboratory exercises present basic microbiological techniques and illustrate from a chemical viewpoint some of the basic microbial aspects of waste disposal.

CE 571 THEORY OF WATER AND WASTE TREATMENT

3 (3-0) F

Prerequisite: Graduate standing

Study of the physical, chemical and biological principles underlying water and waste treatment processes; including diffusion of gases, solubility, equilibrium and ionization, aerobic and anaerobic stabilization processes, sludge conditioning and disposal.

CE 572 UNIT OPERATIONS AND PROCESSES IN WASTES ENGINEERING

3 (1-6) S

Prerequisite: CE 571

Processes and operations in wastes engineering; including sedimentation, coagulation, filtration, adsorption, biological treatments, softening and new developments.

CE 573 ANALYSIS OF WATER AND WASTES

3 (1-6) F

Corequisite: CE 571

Chemical and physical analysis of water and wastes and interpretation of results.

CE 574 RADIOACTIVE WASTE DISPOSAL

3 (2-3) FS

Prerequisite: PY 407

Unit operations and processes employed in treatment and disposal of radioactive wastes.

CE 575 CIVIL ENGINEERING SYSTEMS

3 (3-0) S

Prerequisite: MA 405

An examination of civil engineering systems and their design optimization. The systems to be studied include water resources engineering, structural engineering, transportation engineering and construction.

CE 576 ATMOSPHERIC POLLUTION

3 (3-0) S

Prerequisite: Graduate or advanced undergraduate standing

A survey of the problem of atmospheric pollution. Topics to be discussed include: pollutant sources; effects on man and other animals, vegetation, materials and visibility; meteorological factors; air sampling, control devices; air quality and emission standards; and legal, economic and administrative aspects.

CE 580 FLOW IN OPEN CHANNELS

3 (3-0) FS

Prerequisite: CE 483

The theory and application of flow in open channels, including dimensional analysis, momentum-energy principle, gradually varied flow, high-velocity flow, energy dissipators, spillways, waves, channel transitions and model studies.

CE 581 (MAS 581) INTRODUCTION TO OCEANOGRAPHIC ENGINEERING

3 (3-0) F

Prerequisite: EM 303

A rigorous treatment of the engineering aspects of physical oceanography. The theory for the propagation of waves, methods of wave forecasting and the analysis of wave spectra are presented. The applications of physical oceanography to the design of marine and coastal installations are shown.

CE 591, 592	CIVIL ENGINEERING SEMINAR	1 (1-0) FS
	Discussions and reports of subjects in civil engineering and allied fields.	
CE 598	CIVIL ENGINEERING PROJECTS	1-6 FS
	Special projects in some phase of civil engineering.	

FOR GRADUATES ONLY

CE 601	TRANSPORTATION PLANNING	3 (3-0) S
CE 602	ADVANCED TRANSPORTATION DESIGN	3 (2-3) F
CE 603	AIRPORT PLANNING AND DESIGN	3 (2-3) F
CE 604	URBAN TRANSPORTATION PLANNING	3 (3-0) S
CE 605	TRAFFIC FLOW THEORY	3 (3-0) F
CE 623	THEORY AND DESIGN OF ARCHES	3 (3-0) F
CE 624	ANALYSIS AND DESIGN OF STRUCTURAL SHELLS AND FOLDED PLATES	3 (3-0) S
CE 625, 626	ADVANCED STRUCTURAL DESIGN I, II	3(2-3) FS
CE 627	DESIGN OF STRUCTURES FOR DYNAMIC LOADS	3 (3-0) S
CE 631	FIELD ANALYSIS OF STRUCTURAL SYSTEMS	3 (3-0) F
CE 635	ADVANCED THEORY OF CONCRETE STRUCTURES	3 (3-0) S
CE 641, 642	ADVANCED SOIL MECHANICS	3 (3-0) FS
CE 643	HYDRAULICS OF GROUND WATER	3 (3-0) FS
CE 644	GROUND WATER ENGINEERING	3 (3-0) F
CE 646	DYNAMICS OF SOILS AND FOUNDATIONS	3 (3-0) F
CE 651	THEORY OF LIMIT ANALYSIS	3 (3-0) F
CE 652	INELASTIC SOLIDS AND STRUCTURES	3 (3-0) S
CE 671	ADVANCED WATER SUPPLY AND WASTE WATER DISPOSAL	4 (3-3) F
CE 672	ADVANCED WATER AND WASTES TREATMENT	4 (3-3) S
CE 673	INDUSTRIAL WATER SUPPLY AND WASTE DISPOSAL	3 (3-0) FS
CE 674	STREAM SANITATION	3 (3-0) FS
CE 698	SPECIAL TOPICS IN CIVIL ENGINEERING	1-3 FS
CE 699	CIVIL ENGINEERING RESEARCH	Credits Arranged

COMPUTER SCIENCE

CSC 101 INTRODUCTION TO PROGRAMMING

3 (3-1) F S

Understanding algorithms, programs and computers. Basic programming and program structure. Programming and computing systems. Debugging and verification of programs. Data representation. Organization and characteristics of computers. Survey of computers. Languages, systems and applications. Computer solution of several numerical and nonnumerical problems using one or more programming languages.

CSC 111 ALGORITHMIC LANGUAGES I

2 (2-1) F S

Corequisite: MA 102

Introduction to a problem-oriented computer language for use in problem solution using digital computers. This language currently is FORTRAN IV. This course is designed as a two hour service course for scientifically oriented students, primarily for the School of Engineering. Programs to be written for this course will be slanted toward engineering applications.

CSC 112 BASIC COMPUTER ORGANIZATION AND ASSEMBLY LANGUAGE

3 (3-0) F S

Prerequisite: CSC 101 or CSC 111

Brief historical background of computers and computing. Computer structure, machine language, instruction execution, addressing techniques and digital representation of data. Computer systems organization. Symbolic coding and assembly systems. Introduction to macros, program segmentation, linkage and programming techniques.

CSC 211 PROGRAMMING LANGUAGES

3 (3-0) F S

Prerequisite: CSC 101 or CSC 111

Formal definition of programming languages including specification of syntax and semantics. Simple statements including precedence, infix, prefix and postfix notation. Global properties of algorithmic languages including scope of declarations, storage allocation, grouping of statements, binding times of constituents, procedures, coroutines and tasks. Data structures and data management in a programming language. Language features for list-processing, string manipulation, data description and simulation. Compile-time features in a programming language. Run-time representation of program and data structures.

CSC 301 PRINCIPLES OF SYSTEMS PROGRAMS

3 (3-0) F S

Prerequisite: CSC 112

Definition, call and expansion of macros. Job control language. Supervisory services. Program sectioning and linking in an assembler. Data management services. Data management processing procedures. Data set disposition and space allocation. Characteristics and use of tapes, disks, drums, cores, data-cells and other large-volume devices in storage hierarchies. Loaders and link-editors. Accounting programs. Program libraries. Multiple processor configurations, computer networks and remote access terminals.

CSC 302 INTRODUCTION TO NUMERICAL METHODS

3 (3-0) F S

Prerequisite: CSC 101 or CSC 111

Corequisite: MA 301 or MA 312

Computer techniques used to translate certain known computational algorithms into computer programs; practice in use of routines already available in the university program library. Areas of interest: linear systems of equations; curve fitting and interpolation; algorithms for differentiation; solution of nonlinear equations, and solution of ordinary differential equations. Elementary discussion of errors.

CSC 311 DATA STRUCTURES**3 (3-0) F S****Prerequisites:** CSC 112, CSC 211**Corequisite:** CSC 322

Basic concepts of data. Linear lists, strings, arrays and orthogonal lists. Representation of trees and graphs. Storage systems and structures, and storage allocation and collection. Multilinked structures. Symbol tables and searching techniques. Sorting (ordering) techniques. Formal specification of data structures, data structures in programming, and generalized data management systems. Assigned problem set for course will include options which stress business data processing applications for those students interested in management science.

CSC 312 COMPUTER ORGANIZATION AND LOGIC**3 (3-0) F S****Prerequisite:** CSC 322 or equivalent

Introduction to Boolean algebra, symbolic logic as used in computer organization, switching circuits, arithmetic circuits, application of logic to problem solving.

CSC 322 APPLIED ALGEBRAIC STRUCTURES**3 (3-0) F S****Prerequisites:** CSC 211, MA 231

Naive set theory, order and equivalence relations, partitions and congruences. Lattices, Boolean algebra, semigroups, groups, rings, fields, graph theory. Logic of propositions, first order predicate calculus, models for a theory. Applications and examples of these algebraic structures in formal language description, data structures, file organization, information retrieval, games, switching circuits, neural nets, sequential machines, artificial intelligence, syntactic structure of arithmetic expressions and theory of algorithms.

CSC 411 INTRODUCTION TO SIMULATION**3 (2-2) F****Prerequisite:** CSC 311 or equivalent

This course is designed to introduce simulation concepts and methodology to computer science students and students from other curricula. Modeling and computational techniques, Monte Carlo methods and interactive simulation are discussed. Applications from the areas of interest of the students are used to illustrate the concepts presented in the lectures. In the laboratory, students will perform both analog and digital simulations and will be expected to complete an individual term project.

CSC 412 INTRODUCTION TO COMPUTABILITY, LANGUAGE AND AUTOMATA**3 (3-0) S****Prerequisite:** CSC 311

Sequential machines as abstractions of digital computers described by state-transition graph. Sequential machines as language acceptors and as the finite control of a Turing machine. Chomsky classification of languages and machines. Universal Turing machines and the halting problem. Church's thesis. Recursive functions. Discussion with heuristic argument that a function is recursive if and only if it is Turing computable. Discussion of the semigroup word problem and tree searching algorithm. Applications to artificial intelligence, perception simulation, game playing, syntactic analysis algorithms.

CSC 421 COMPUTER SYSTEMS FOR MANAGEMENT**3 (3-0) F****Prerequisite:** CSC 311

An introduction to the principles and techniques of systems design, integration and implementation related to the development of large scale management information structures. Decision criteria in the adaptation of a management system to existing or proposed computer configurations. Updating and support of the systems management function. Model building. Planning and forecasting.

CSC 431 INFORMATION RETRIEVAL**3 (3-0) S****Prerequisite:** CSC 311

Structure of semiformal languages and models for the representation of structured information. The analysis of information content by statistical, syntactic and logical methods. Search and matching techniques. Automatic retrieval systems, question-answering systems. Production of secondary outputs. Evaluation of retrieval effectiveness. Programming exercises applying techniques discussed in lecture will be assigned.

CSC 432 INTRODUCTION TO DIGITAL SIGNAL PROCESSING**3 (2-2) S****Prerequisites:** CSC 302, ST 371 and MA 231 or MA 405

This course is an introduction to the use of digital computers in the acquisition and analysis of data. Laboratory work will include hands-on computer experience. The methods developed will apply to both the biological and physical sciences.

CSC 495 SPECIAL TOPICS IN COMPUTER SCIENCE**1-6 F S****Prerequisite:** Consent of instructor

This course is designed to serve needs not covered by existing courses. It will consist of one or more of the following types of study. Readings in the literature of computer science, introductory research projects, major computer programming projects, seminars or new course development. Work may be done in any area of computer science such as software, hardware utilization, programming languages, numerical methods or telecommunications.

CSC 501 DESIGN OF SYSTEMS PROGRAMS**3 (3-0) F****Prerequisites:** CSC 301, CSC 311, CSC 312

Review of batch process systems programs, their components, operating characteristics, user services and their limitations. Implementation techniques for parallel processing of input-output and interrupt handling. Overall structure of multiprogramming systems on multiprocessor hardware configurations. Details on addressing techniques, core management, file system design and management, system accounting, and other user-related services. Traffic control, interprocess communication, design of system modules and interfaces. System updating, documentation and operation.

CSC 502 COMPUTATIONAL LINGUISTICS**3 (3-0) S****Prerequisite:** Consent of instructor

Use of a symbol manipulation language (SNOBOL 4) in solving nonnumeric problems. Study of generative grammars, including finite-state, context-free, context-sensitive, and transformational grammars. Syntactic analysis by computers: algorithms and existing analysis systems for English. Computational semantics. Information retrieval and question-answering systems. This course is open to computer science students and those in other fields.

CSC 504 APPLICATION OF LINGUISTIC TECHNIQUES TO COMPUTER PROBLEMS**3 (3-0) S****Prerequisite:** CSC 502

Characterization of various programming languages according to the theory of transformational grammar. Automatic translations between these languages. Design of a formal language for semantics. Iconography. Design of a language for movements of artificial speech organs; automatic translation from phonetic transcriptions to expressions in such a language.

CSC 511 ARTIFICIAL INTELLIGENCE**3 (3-0) F****Prerequisite:** CSC 311

Definition of heuristic versus algorithmic methods, rational of heuristic approach, description of cognitive processes. Objectives of work in artificial

intelligence, simulation of cognitive behavior. Heuristic programming techniques. Survey of examples from representative application areas. The mind-brain problem and the nature of intelligence. Individual projects to illustrate basic concepts.

CSC 512 METAPROGRAMS

3 (3-0) S

Prerequisite: CSC 312 or consent of instructor

The following course is intended to provide a detailed understanding of the techniques used in the design and implementation of compilers. Review of program language structures, translation, loading, execution and storage allocation. Compilation of simple expressions and statements. Organization of a compiler including compile time and run-time symbol tables, lexical scan object code generation, error diagnostics, object code optimization techniques and overall design.

CSC 522 FORMAL LANGUAGES AND SYNTACTIC ANALYSIS

3 (3-0) F

Prerequisites: CSC 211, CSC 311, CSC 512 (recommended)

Definition of formal grammars: Arithmetic expressions and precedence grammars, context-free and finite-state grammars. Algorithms for syntactic analysis: recognizers, backtracking, operator precedence techniques. Semantics of grammatical constructs: Floyd productions, simple syntactical compilation. Relationship between formal languages and automata.

CSC 527 (MA 527) NUMERICAL ANALYSIS I

3 (3-0) F S

Prerequisites: CSC 101 or CSC 111, MA 301 or MA 312, MA 231 or MA 405

Theory of interpolation, numerical integration, iterative solution of nonlinear equations, numerical integration of ordinary differential equations, matrix inversion and solution of simultaneous linear equations.

CSC 528 (MA 528) NUMERICAL ANALYSIS II

3 (3-0) F S

Prerequisite: MA 527

Least squares data approximation, expansions in terms of orthogonal functions, Gaussian quadrature, economization of series, minimax approximations, Padé approximations, eigenvalues of matrices.

CSC 532 ARTIFICIAL INTELLIGENCE II

3 (3-0) S

Prerequisites: CSC 511, course in mathematical logic

A rigorous approach to artificial intelligence emphasizing pattern recognition, theorem proving, game playing, learning and heuristic programming. Students will be assigned computer projects illustrating theoretical concepts introduced in lecture.

CSC 595 SPECIAL TOPICS

1-6 F S

Prerequisite: Consent of instructor

Topics of current interest in computer science not covered in existing courses.

CSC 603 COMPUTATIONAL SEMANTICS

3 (3-0) F

CROP SCIENCE

FOR UNDERGRADUATES

CS 211 CROP SCIENCE

3 (3-0) F S

Prerequisite: BS 100

A study of the fundamental morphological, physiological and reproductive features of the higher plant which determine its value as a crop. The plant response

to the natural and artificial environments associated with modern cultural practices will also be discussed. Mr. Emery

CS 214 CROP SCIENCE LABORATORY 1 (0-2) F S
Prerequisite or corequisite: Any crop science course
Can be taken only once for credit.

The laboratory course will evaluate methods of identifying and dealing with the problems of growing and managing crop plants. Messrs. Emery, Fike

CS 311 FIELD CROP PRODUCTION 3 (3-0) F
Prerequisites: CS 211, SSC 200 or consent of instructor

Crop characteristics and varieties, environmental factors, rotations, control of pests and other production practices associated with the major cash crops of North Carolina and the United States. Mr. Fike

CS 312 PASTURES AND FORAGE CROPS 3 (3-0) S
Prerequisite: BS 100, SSC 200 recommended

A study of the production and preservation of the principal forage crops. Special attention is given to the development and maintenance of pastures. Mr. Chamblee

CS 315 TURF MANAGEMENT 3 (2-2) S
Prerequisite: BS 100

Basic principles of turf production and their practical application to establishment, maintenance, renovation and pest control of lawns, playgrounds, sports fields, road areas and similar specialized turf areas. Mr. Gilbert

CS 413 PLANT BREEDING 3 (3-0) S
Prerequisite: GN 411

An appreciation course in plant breeding. Discussion topics include reproductive systems of higher plants; the evolution and utilization of natural and induced genetic variability; the development of appropriate selection and breeding methods; and the distribution and maintenance of improved varieties. Mr. Emery

CS 414 WEED SCIENCE 3 (2-2) F
Prerequisite: CH 220 or equivalent

Principles involved in cultural and chemical weed control. Discussions on chemistry of herbicides and the effects of the chemicals on the plant. Identification of common weeds and their seeds is given. Mr. Worsham

CS 490 SENIOR SEMINAR IN CROP SCIENCE 1 (1-0) S
Prerequisite: Senior standing

The collection, organization, written preparation and oral delivery of scientific information concerning topics of interest in crop science. Mr. Emery

FOR GRADUATES AND ADVANCED UNDERGRADUATES

CS 511 TOBACCO TECHNOLOGY 2 (2-0) S
Prerequisites: CS 311, BO 421 or equivalent

A study of special problems concerned with the tobacco crop. The latest research problems and findings dealing with this important cash crop will be discussed. Mr. Collins

- CS 513 PHYSIOLOGICAL ASPECTS OF CROP PRODUCTION 3 (3-0) S
Prerequisite: BO 421
Discussion will emphasize pertinent physiological processes associated with crops and crop management such as plant growth, maturation, respiration and photoperiodism. Relationship of the environment to maximum crop yields will be discussed.
Mr. Fike
- CS 514 (HS 514) PRINCIPLES AND METHODS IN WEED SCIENCE 3 (2-2) S
Prerequisite: CS 414 or equivalent
Studies on the losses caused by the ecology of weeds, biological control, basic concepts of weed management, herbicide-crop relationships and herbicide development. Introduction to greenhouse and bioassay techniques and field research techniques.
Messrs. Monaco, Schrader
- CS 541 (GN 541, HS 541) PLANT BREEDING METHODS 3 (3-0) F
Prerequisites: GN 506, ST 511
An advanced study of methods of plant breeding as related to principles and concepts of inheritance.
Messrs. Haynes, Wernsman
- CS 542 (GN 542, HS 542) PLANT BREEDING FIELD PROCEDURES 2 (0-4) Sum.
Prerequisite: CS 541 (GN 541, HS 541)
Laboratory and field study of the application of the various plant breeding techniques and methods used in the improvement of economic plants. Mr. Harvey
- CS 545 (GN 545) ORIGIN AND EVOLUTION OF CULTIVATED PLANTS 2 (2-0) S
Prerequisite: CS 541 or GN 540
Discussion topics include: mankind as a potential cultivator; man's anatomy, physiology and alimentary needs; origins of cultivation; spread of agriculture in terms of various theories; interactions of crops and environments with reference to crop evolution; special attributes of cultigens; modern aspects of evolution (breeding). (Offered spring, 1972 and alternate years.)
Mr. Lee
- CS 550 THE CHEMISTRY OF TOBACCO AND SMOKE 2 (2-0) S
Prerequisites: BO 421 and CH 220 or equivalent
The course emphasizes the composition of smoke, the combustion process and factors modifying the composition of smoke; the composition of tobacco and factors affecting the composition of tobaccos during growth, curing and ageing.
Mr. Weybrew
- CS 591 SPECIAL PROBLEMS Credits Arranged
Prerequisite: Consent of instructor
Special problems in various phases of crop science. Problems may be selected or will be assigned. Emphasis will be placed on review of recent and current research.
Graduate Staff

FOR GRADUATES ONLY

Students are to consult the instructor before registration.

- CS 613 (GN 613, HS 613) PLANT BREEDING THEORY 3 (3-0) S
- CS 614 (HS 614, SSC 614) HERBICIDE BEHAVIOR IN PLANTS AND SOILS 3 (3-0) F

DESIGN

DN 101, 102 ENVIRONMENTAL DESIGN I, II 4 (1-9) FS

Prerequisites: (101) A major in the School of Design or consent of the dean; (102) DN 101

Investigation of the sensory environment as a design determinant. Emphasis is centered on individual discovery by the student who must function in problem formulating and problem-solving processes. The course was designed to develop technical skills simultaneously with the development of conceptual models. Staff

DN 111, 112 PERCEPTION AND COMMUNICATION I, II 2 (1-3) FS

Prerequisites: (111) A major in the School of Design or consent of the dean; (112) DN 111

Studies designed to increase perceptual awareness and communication skills through exercises in various communications media. Staff

DN 121, 122 HISTORY OF DESIGN, I, II 3 (3-0) FS

Prerequisite: (122) DN 121

A critical study of the related design fields from prehistoric periods to the modern era with reference to the social, political and technological movements which affected their development. Mr. Reuer

DN 201, 202 ENVIRONMENTAL DESIGN III, IV 4 (1-9) FS

Prerequisites: (201) DN 102; (202) DN 201

An introduction to the disciplines of architecture, landscape architecture and product design through environmental studies and investigation of materials and processes. Emphasis is placed on organizing and solving design problems. Staff

DN 211, 212 VISUAL COMMUNICATION I, II 2 (0-6) FS

Prerequisites: (211) DN 112; (212) DN 211

Visual communications processes as they support design activities. Two- and three-dimensional studies as related to conceptual and definitive aspects of the design process. Exercises are aimed at developing a mastery of both technical and nontechnical methods of visual communication. Staff

DN 311, 312 ADVANCED VISUAL LABORATORY I, II 2-4 FS

Prerequisites: DN 111, DN 112, DN 211, DN 212

Extension of problems introduced in first- and second-year drawing on a more advanced level. Problems will involve the human figure and its environment and investigate techniques to increase the ability of the student to express his ideas in varied forms. Staff

DN 411, 412 ADVANCED VISUAL LABORATORY III, IV 2-4 FS

Prerequisites: DN 311, DN 312

Advanced problems in the fields of painting, sculpture, graphics and photography. Staff

DN 421, 422 HISTORY OF DESIGN III, IV 3 (3-0) FS

Prerequisite: DN 122

Specialized historical studies in design fields. Staff

DN 481 HISTORY OF ASIAN DESIGN**3 (3-0) FS****Prerequisites:** DN 121, DN 122 for students in the School of Design**No history prerequisite is required.**

A study of the historic and religious backgrounds of the cultures of Asia and a consideration of architecture, landscape, painting, sculpture and the minor arts from prehistory to the present.

Staff**FOR GRADUATES AND ADVANCED UNDERGRADUATES****DN 511, 512 ADVANCED VISUAL LABORATORY V, VI****2 (0-6) FS****Prerequisite:** Graduate standing

Advanced experimental studies in visual phenomena related to design. **Staff**

DN 541 SEMINAR ON IDEAS IN DESIGN**2 (2-0) FS****Prerequisite:** Graduate standing

An examination of aesthetics and the relationships of philosophic thought to design.

Dean Kamphoefner**FOR GRADUATES ONLY****DN 611, 612 ADVANCED VISUAL LABORATORY VII, VIII****2 (0-6) FS****ECONOMICS****FOR UNDERGRADUATES****EC 205 ECONOMIC ACTIVITY****3 (3-0) FS**

An introductory study of economic activity with emphasis on national economic problems.

EC 206 THE PRICE SYSTEM**3 (3-0) FS**

An introductory study of the determination of prices, wages and value; an analysis of the process and principles by which an economy allocates resources.

EC 212 ECONOMICS OF AGRICULTURE**3 (3-0) FS****Prerequisite:** MA 111

An introduction to the economic principles underlying agricultural production and marketing; organization for production in agriculture; consumers and their influence upon the demand for agricultural products; relationships between agriculture and other segments of the economy; dynamic factors in the economy which affect agriculture.

EC 301 PRODUCTION AND PRICES**3 (3-0) FS****Prerequisite:** EC 206 or EC 212

An intensive study of the functioning of the market economy. An examination of the role of prices in determining the allocation of resources, the functioning of the firm in the economy, and forces governing the production of economic goods.

EC 302 NATIONAL INCOME AND ECONOMIC WELFARE**3 (3-0) F S****Prerequisite:** EC 205

An intensive examination of factors determining the national income. The economic and social effects of the level, composition and distribution of national income will be studied with reference to theories of economic welfare and to public policy.

EC 303 FARM MANAGEMENT**3 (2-2) F S****Prerequisite:** EC 212

An application of basic economic principles and techniques to the problems facing a farm business; use of budgeting, programming, systems analysis and other modern techniques to determine what, how and how much to produce when faced with numerous alternatives; analysis of problems associated with farm size and the acquisition of adequate resources; use and analysis of farm records as an aid to better management. Two all-day Saturday field trips are required of all students.

EC 310 ECONOMICS OF THE FIRM**3 (3-0) F S****Prerequisite:** EC 205 or EC 206 or EC 212

An examination of the economic setting within which the business firm makes decisions, and an application of economic analysis to these decisions. Economics from the focal point of managerial decision-making.

EC 311 AGRICULTURAL MARKETS**3 (2-2) S****Prerequisite:** EC 212

A study of the agricultural marketing system and the current economic forces affecting its structure and efficiency; decision-making by agricultural business firms, with some discussion of integration and interfirm relationships. Effects of monopoly in marketing relative to government policies of control. Classroom discussion is supplemented by visits to marketing firms and by practical problems illustrating firm decisions. A laboratory period will be included in alternate weeks beginning with the second full week of classes. Students are expected to examine individually the marketing problems associated with the commodity of their choice.

EC 312 ACCOUNTING I**3 (2-1) F S**

Introductory and problem materials designed to provide an understanding of accounting data, its accumulation and measurements as a tool of applied economics and its employment by management. This course deals with concepts and tools of analysis necessary for the selection, quantification and communication of business transactions through the accounting process. Individual ownerships, partnerships and corporations are studied, with emphasis on the corporate form of organization.

EC 313 ACCOUNTING II**3 (2-1) F S****Prerequisite:** EC 312

A second semester course in accounting with emphasis on managerial use in decision-making. Concepts and methods pertinent to the accumulation, organization and interpretation of data useful in evaluating, planning and controlling the performances of the business enterprise.

EC 317 INTRODUCTION TO METHODS OF ECONOMIC ANALYSIS**3 (3-0) F S****Prerequisite:** EC 301

This course treats the fundamentals of quantitative methods and economic models in the application to economic and industrial problems. Through the study of economic variables and their parameters it lays the groundwork for later study of firm and consumer behavior. Analysis of the supply and demand sides of the market equation is emphasized. There is further examination of the economic structure from the standpoint of multiple markets and the general economy.

EC 370 (HI 370) THE RISE OF INDUSTRIALISM**3 (3-0) F****Prerequisites:** EC 206, HI 102

The pattern of historical development of the modern industrial economy is studied. Origins in 16th century England, the origins of capitalism are related to succeeding developments there in the overseas colonial empire and in the remainder of the areas influenced by that development.

EC 402 FINANCIAL INSTITUTIONS**3 (3-0) F S****Prerequisite:** EC 302

An examination of the flow-of-funds among the principal financial institutions in the American economy; the behavior of the money and capital markets; and the allocation of savings flows into investment expenditures.

EC 407 BUSINESS LAW I**3 (3-0) F S****Prerequisites:** EC 205, EC 206 or EC 212

A course dealing with elementary legal concepts, contracts, agency, negotiable instruments, sales of personal property and insurance. Uniform commercial code considered under all titles applicable.

EC 408 BUSINESS LAW II**3 (3-0) F S****Prerequisite:** EC 407

Deals with real property, bailments, partnerships, corporations, chattel mortgages, mortgages on real estate, landlord and tenant, insurance, wills, suretyship, conditional sales and bankruptcy. Uniform commercial code considered under all titles applicable.

EC 409 INTRODUCTION TO PRODUCTION COST**3 (3-0) F S****Prerequisite:** EC 312

An introduction to accounting for manufacturing, fabrication and construction type enterprises. The determination and allocation of costs of materials, labor and overhead. Special emphasis is placed on managerial analysis, interpretation and control of cost data.

EC 410 PUBLIC FINANCE AND FISCAL POLICY**3 (3-0) F****Prerequisites:** EC 205, EC 206; EC 301 recommended

An analysis of the economic effects of government taxation and expenditure decisions. Major attention will be given to current tax policy issues both at the federal level and at the state-local level. A description of different types of budgets and the effect of budgetary policy upon the level of economic activity will also be included.

EC 411 MARKETING METHODS**3 (3-0) F S****Prerequisites:** EC 205, EC 206 or EC 212

Marketing institutions and their functions and agencies; retailing, market analysis; problems in marketing.

EC 413 COMPETITION, MONOPOLY, AND PUBLIC POLICY**3 (3-0) S****Prerequisite:** EC 301 recommended but not required

An analysis of the effect of modern industrial structure on competitive behavior and performance, in the light of contemporary price theory and the theory of workable competition. A critical evaluation of the legislative content, judicial interpretation and economic effects of the antitrust laws.

EC 414 TAX ACCOUNTING**3 (2-1) F****Prerequisite:** EC 312

An analysis of the Federal tax laws relating to the individual and business.

Determining and reporting income. Payroll taxes and methods of reporting them. Actual practice in the preparation of income tax returns.

EC 415 FARM APPRAISAL AND FINANCE

3 (2-3) F

Prerequisite: EC 303

Examination of the source of the productivity and value of farm inputs; a critical analysis of, and practice in the use of farm appraisal procedures currently used for land and buildings; review of the sources of, and repayment practices used in short and intermediate credit in agriculture; consideration of the forces operating in the whole economy with an examination of the implications of these changes for both the lender and borrower in agriculture.

EC 420 CORPORATION FINANCE

3 (3-0) F S

Prerequisites: EC 205, EC 312

Financial instruments and capital structure; procuring funds; managing working capital; managing corporate capitalization; financial institutions and their work.

EC 425 INDUSTRIAL MANAGEMENT

3 (3-0) F S

Prerequisite: Junior standing

Principles and techniques of modern scientific management; relation of finance, marketing, industrial relations, accounting and statistics to production planning and control; analysis of economic, political and social influences on production.

EC 426 PERSONNEL MANAGEMENT

3 (3-0) F S

Prerequisite: Junior standing

The scientific management of manpower, from the viewpoint of the supervisor and personnel specialist. A study of personnel policy and a review of the scientific techniques regarding the specific problems of employment, training, promotion, transfer, health and safety, employee service and joint relations.

EC 430 AGRICULTURAL PRICE ANALYSIS

3 (3-0) F

Prerequisite: EC 311

Principles of price formation; the role of price in the determination of economic activity; the interaction of cash and future prices for agricultural commodities; methods of price analysis, construction of index numbers, analysis of time series data including the estimation of trend and seasonal variations in prices.

EC 431 LABOR ECONOMICS

3 (3-0) F S

Prerequisite: EC 301 recommended but not required

An economic approach to the labor market and to labor market problems including unemployment and the determination of wages, hours and working conditions under various labor market structures. An examination of the economic effects of trade unions and an introduction to the theory of human capital.

EC 432 INDUSTRIAL RELATIONS

3 (3-0) F S

Prerequisite: EC 205 or EC 212

Collective bargaining. Analysis of basic labor law and its interpretation by the courts and governmental agencies. An examination of specific terms of labor contracts and their implications for labor and management. An examination of labor objectives and tactics and management objectives and tactics. Problems of operating under the labor contract.

EC 440 ECONOMIC DEVELOPMENT

3 (3-0) S

Prerequisite: EC 302

An examination of the institutional background required for national economic development. The conditions apparent for past growth of nations are compared

with conditions obtained in presently retarded nations. Conclusions are drawn from this comparison to provide an introduction to the theoretical models of growth.

EC 441 AGRICULTURAL DEVELOPMENT IN FOREIGN COUNTRIES 3 (3-0) F
Prerequisite: EC 205 or EC 206 or EC 212

Identification of agricultural problems in underdeveloped countries; a review of economic criteria for analyzing the problems of developing agriculture and the techniques of analysis for solving such problems. Case studies of development programs in various countries will be discussed.

EC 442 EVOLUTION OF ECONOMIC IDEAS 3 (3-0) S
Prerequisite: EC 301

An analysis of the development of economic thought and method during the past two centuries. Economics as a cumulative body of knowledge in a context of emerging technology, changing institutions, pressing new problems and the growth of science.

EC 448 INTERNATIONAL ECONOMICS 3 (3-0) F
Prerequisites: EC 205, EC 206 or EC 212

A study of international economics, including trade, investment, monetary relations and certain aspects of economic development. Emphasis upon analytical and policy approaches, although some institutional material is included.

EC 451 INTRODUCTION TO ECONOMETRICS 3 (3-0) F S
Prerequisites: EC 301, EC 302, EC 317 or ST 311

An introduction to the measurement, specification, estimation and interpretation of functional relationships through single equation least-squares techniques. Simple and multiple regression, curvilinear regression and various transformations will be used to measure: demand, cost, production, consumption and investment relationships.

EC 470 (HI 470) EVOLUTION OF THE AMERICAN ECONOMY 3 (0-3) FS
Prerequisites: EC 206; HI 112 or HI 348 or HI 412

The continuing advances of modern industrialization are related to the development of the American nation. Contemporary problems and issues are analyzed with reference to the origins in the historical growth of the economy.

EC 475 COMPARATIVE ECONOMIC SYSTEMS 3 (3-0) F
Prerequisite: EC 205 or EC 206

A general study of different economic systems. Concentration will be given to capitalist or market economies and these will be contrasted with collectivist types of systems. Emphasis will be given to the Soviet economy.

EC 482 (TX 482) SALES MANAGEMENT FOR TEXTILES 3 (3-0) S
(See textile technology, page 449.)

EC 490, 491 SENIOR SEMINARS IN ECONOMICS 3 (3-0) F S
Prerequisites: EC 301, EC 302

The terminal courses in undergraduate study of economics. The student is assisted in summarizing his training, and in improving his capacity to recognize problems and to select logically consistent means of solving the problems. This is done on a small-group and individual basis.

EC 494, 495 (PS 494, 495, SOC 494, 495) URBAN SEMINAR 3 (0-3) FS
(See politics, page 413.)

FOR GRADUATES AND ADVANCED UNDERGRADUATES

EC 501 PRICE THEORY

3 (3-0) F S

Prerequisite: EC 301

An intensive analysis of the determination of prices and of market behavior, including demand, cost and production, pricing under competitive conditions, and pricing under monopoly and other imperfectly competitive conditions.

EC 502 INCOME AND EMPLOYMENT THEORY

3 (3-0) F S

Prerequisite: EC 302

A study of the methods and concepts of national income analysis with particular reference to the role of monetary and fiscal policy in maintaining full employment without inflation.

EC 510 (PS 510) PUBLIC FINANCE

3 (3-0) F S

Prerequisite: EC 205

A survey of the theories and practices of governmental taxing, spending and borrowing, including intergovernmental relationships and administrative practices and problems.

EC 515 WATER RESOURCES ECONOMICS

3 (3-0) S

Prerequisite: Graduate standing

The application of economic principles in the allocation of water resources. Attention is given especially to the basic issues of how to effect maximum economic efficiency in the use of a resource that is no longer a free good, under the consideration of the goals of the public and private sectors of the enterprise economy. Both economic and political consequences of decision-making are studied.

EC 521 MARKETS AND TRADE

3 (3-0) F

Prerequisite: EC 301

A study of marketing firms as producers of marketing services and their role in the pricing process; the influence of government policies on the behavior of marketing firms; methods for increasing the efficiency of marketing agricultural products.

EC 523 PLANNING FARM AND AREA ADJUSTMENTS

3 (2-2) S

Prerequisite: EC 303

The application of economic principles in the solution of production problems on typical farms in the state; methods and techniques of economic analysis of the farm business; application of research findings to production decisions; development of area agricultural programs.

EC 525 MANAGEMENT POLICY AND DECISION MAKING

3 (3-0) F S

Prerequisite: EC 301

A review and consideration of modern management processes used in making top-level policies and decisions. An evaluation of economic, social and institutional pressures, and of the economic and noneconomic motivations, which impinge upon the individual and the organization. The problem of coordinating the objectives and the mechanics of management is examined.

EC 533 AGRICULTURAL POLICY

3 (3-0) S

Prerequisite: EC 301

A review of the agricultural policy and action programs of the federal government as regards both input supply and commodities; analysis of objectives, principal means and observable results as regards resource use and income distribution within agriculture, and between agriculture and the rest of the economy; appraisal of the effects alternative policy proposals would have on domestic and foreign consumption.

EC 535 SOCIAL SCIENCE CONCEPTS IN MANAGERIAL PROCESSES 3 (3-0) S
Prerequisite: Six hours in economics

Interrelationships between concepts from economics and from other social sciences in managerial processes of clarifying goals, discovering alternatives and choosing courses of action. Cases are used to provide opportunities to compare contributions of theoretical concepts from economics, political science, social psychology, sociology and management science to managerial processes. Theoretical concepts are drawn from readings in the various disciplines.

EC 550 MATHEMATICAL MODELS IN ECONOMICS 3 (3-0) S
Prerequisites: EC 301, EC 302, MA 212 and MA 405 recommended but not required

An introductory study of economic models emphasizing their formal properties. The theory of individual economic units is presented as a special case in the theory of inductive behavior. Mathematical discussions of the theory of the consumer, the theory of the firm and welfare economics will show the relevance of such topics as constrained maxima and minima, set theory, partially and simply ordered systems, probability theory and game theory to economics.

EC 551 AGRICULTURAL PRODUCTION ECONOMICS 3 (3-0) F
Prerequisite: EC 301

An economic analysis of agricultural production including: production functions, cost functions, programming and decision-making principles and the applications of these principles to farm and regional resources allocation, and to the distribution of income to and within agriculture.

EC 555 LINEAR PROGRAMMING 3 (3-0) F S
Prerequisites: EC 301, MA 212, MA 405

Recent developments in the theory of production, allocation and organization. Optimal combination of integrated productive processes within the firm. Applications in the economics of industry and of agriculture.

EC 561 (ST 561) INTERMEDIATE ECONOMETRICS 3 (3-0) S
Prerequisites: EC 501 and ST 501 or MA 112

The formalization of economic hypotheses into testable relationships and the application of appropriate statistical techniques will be emphasized. Major attention will be given to procedures applicable for single equation stochastic models expressing micro- and macroeconomic relationships. The importance of special statistical considerations that are relevant in working with time series and cross sectional data in economic investigations is to be covered. The use of simultaneous equation models and the available estimation techniques will be surveyed.

EC 570 ANALYSIS OF AMERICAN ECONOMIC HISTORY 3 (3-0) F
Prerequisite: EC 470 or graduate standing

Stresses the application of economic analysis to the formulation and testing of hypotheses concerning economic growth and development in the historical context. Problems selected for analysis will be drawn primarily from American economic history.

EC 585 (TX 585) MARKET RESEARCH IN TEXTILES 3 (3-0) S
(See textile technology, page 450.)

EC 590 SPECIAL ECONOMICS TOPICS Maximum 6
Prerequisite: Consent of instructor

An examination of current problems in economics organized on a lecture-discussion basis. The content of the course will vary as changing conditions require the use of new approaches to deal with emerging problems.

EC 598 TOPICAL PROBLEMS IN ECONOMICS**1-6**

Prerequisite: Consent of instructor

An investigation of topics of particular interest to advanced students under the direction of a faculty member on a tutorial basis. Credits and content will vary with the needs of students.

FOR GRADUATES ONLY

EC 600	ADVANCED PRICE THEORY	3 (3-0) F S
EC 601	PRICES, VALUE AND WELFARE	3 (3-0) F S
EC 602	ADVANCED INCOME AND EMPLOYMENT THEORY	3 (3-0) F S
EC 603	HISTORY OF ECONOMIC THOUGHT	3 (3-0) F S
EC 604	MONETARY ECONOMICS	3 (3-0) F
EC 606	INDUSTRIAL ORGANIZATION AND CONTROL	3 (3-0) F
EC 610	THEORY OF PUBLIC FINANCE	3 (3-0) F S
EC 625	LONG RANGE PLANNING IN BUSINESS AND INDUSTRY	3 (3-0) S
EC 630	LABOR ECONOMICS AND MANPOWER PROBLEMS	3 (3-0) S
EC 631	HUMAN CAPITAL	3 (3-0) F
EC 632	ECONOMIC WELFARE AND PUBLIC POLICY	3 (3-0) S
EC 640	ANALYSIS OF ECONOMIC DEVELOPMENT	3 (3-0) S
EC 641	AGRICULTURAL PRODUCTION AND SUPPLY	3 (3-0) S
EC 642	COMSUMPTION, DEMAND AND MARKET INTERDEPENDENCY	3 (3-0) F
EC 645	PLANNING PROGRAMS FOR ECONOMIC DEVELOPMENT	3 (3-0) F S
EC 648	THEORY OF INTERNATIONAL TRADE	3 (3-0) F
EC 649	MONETARY ASPECTS OF INTERNATIONAL TRADE	3 (3-0) S
EC 650	ECONOMIC DECISION THEORY	3 (3-0) F S
EC 651	(ST 651) ECONOMETRICS	3 (3-0) F
EC 652	(ST 652) TOPICS IN ECONOMETRICS	3 (3-0) S
EC 665	ECONOMIC BEHAVIOR OF THE ORGANIZATION	3 (3-0) F S
EC 699	RESEARCH IN ECONOMICS	Credits Arranged

EDUCATION

FOR UNDERGRADUATES

ED 100 INTRODUCTION TO INDUSTRIAL EDUCATION (See industrial and technical education, page 343.)	2 (2-0) F
ED 101 ORIENTATION (See mathematics and science education, page 370.)	0 (1-0) F S
ED 102 OBJECTIVES IN AGRICULTURAL EDUCATION (See agricultural education, page 239.)	1 (1-0) F
ED 203 INTRODUCTION TO TEACHING MATHEMATICS AND SCIENCE (See mathematics and science education, page 370.)	2 (2-0) F S
ED 304 (PHI 304) PHILOSOPHY OF EDUCATION (See philosophy, page 396.)	3 (3-0) F S
ED 305 ANALYSIS OF TECHNICAL EDUCATION PROGRAMS AND COURSE CONSTRUCTION (See industrial and technical education, page 343.)	3 (3-0) S
ED 308 VISUAL AIDS Methods and techniques of visual instruction; lettering; statistical illustration; chart, graph and poster making; photography, projector operation, care and use.	2 (1-2) S Staff
ED 313 CONTEMPORARY VOCATIONAL AGRICULTURE (See agricultural education, page 239.)	3 (3-0) S
ED 318 (SOC 318) EDUCATIONAL SOCIOLOGY (See sociology, page 430.)	3 (3-0) F S
ED 327 HISTORY AND PHILOSOPHY OF INDUSTRIAL AND TECHNICAL EDUCATION (See industrial and technical education, page 343.)	3 (3-0) F
ED 344 SECONDARY EDUCATION Prerequisite: Junior standing An overview of secondary education, including development, problems, services, trends, teaching profession, role of school in the community; purposes and objectives; the development and status of secondary education in North Carolina. Messrs. Anderson, Shannon	3 (3-0) F S
ED 405 INDUSTRIAL AND TECHNICAL EDUCATION SHOP AND LABORATORY PLANNING (See industrial and technical education, page 344.)	3 (3-0) F
ED 410 DRIVER EDUCATION The principles of teaching basic driving skills, including the new concept of defensive driving, observance and interpretation of motor vehicle laws, adverse driving conditions, handling of accident situations and care of the car.	3 (2-2) S Sum. Staff

- ED 411 STUDENT TEACHING IN AGRICULTURE 6 (2-15) F
(See agricultural education, page 239.)
- ED 412 TEACHING ADULTS 2 (1-2) F
(See agricultural education, page 239.)
- ED 413 PLANNING EDUCATIONAL PROGRAMS 2 (1-2) F
(See agricultural education, page 239.)
- ED 420 PRINCIPLES OF GUIDANCE 2 (2-0) F S
(See guidance and personnel services, page 330.)
- ED 421 PRINCIPLES AND PRACTICES IN INDUSTRIAL COOPERATIVE TRAINING 3 (3-0) F S
(See industrial and technical education, page 344.)
- ED 422 METHODS OF TEACHING INDUSTRIAL SUBJECTS 3, 4 (3-2) F
(See industrial and technical education, page 344.)
- ED 423 METHODS AND MATERIALS IN TEACHING MODERN LANGUAGES 3 (3-0) F S
Prerequisites: PSY 304, ED 344, senior standing and admission to teacher education with a major in modern languages and an overall 2.0 average
A study of the methods of teaching modern languages including the use of appropriate instructional materials and audio-visual equipment. Mr. Reynolds
- ED 424 STUDENT TEACHING IN MODERN LANGUAGES 6 (2-15) F
Prerequisites: PSY 304, ED 344, senior standing and admission to teacher education with a major in French or Spanish and an overall 2.0 average
This course is designed to provide the prospective teacher with an opportunity to acquire experience in the techniques and skills involved in teaching French or Spanish. Each student during the senior year will spend 10 weeks in a selected off-campus center. In addition to acquiring the competencies essential for teaching French or Spanish, the student teacher will also have an opportunity to become familiar with the total school program and to participate in as many school and community activities as time will permit during the period of student teaching. Mr. Reynolds
- ED 428 ORGANIZATION OF RELATED STUDY MATERIALS 3 (3-0) F S
(See industrial and technical education, page 344.)
- ED 440 VOCATIONAL EDUCATION 2 (2-0) F
(See industrial and technical education, page 344.)
- ED 444 STUDENT TEACHING IN INDUSTRIAL SUBJECTS 6 (2-15) F
(See industrial and technical education, page 344.)
- ED 450 METHODS AND MATERIALS IN TEACHING ENGLISH 3 (3-0) F S
Prerequisites: PSY 304, ED 344, senior standing and admission to teacher education with a major in English and an overall 2.0 average
A study of the purposes, curricula, materials and methods of teaching the skills of reading, writing, speaking and listening in secondary schools. Mr. Betts
- ED 451 TEACHING SECONDARY SCHOOL READING 2 (2-0) F S
Prerequisite: Admission to teacher certification program
A study of the nature of the reading process and of principles, methods and

materials for the development of effective reading attitudes and skills as applied both to developmental and remedial programs. Staff

ED 454 STUDENT TEACHING IN ENGLISH 6 (2-15) F S
Prerequisites: PSY 304, ED 344, senior standing and admission to teacher education with a major in English and an overall 2.0 average

This course is designed to provide the prospective teacher with an opportunity to acquire experience in the techniques and skills involved in teaching English. Each student during the senior year will spend 10 weeks in a selected off-campus center. In addition to acquiring the competencies essential for teaching English, the student teacher will also have an opportunity to become familiar with the total school program and to participate in as many school and community activities as time will permit during the period of student teaching. Messrs. Betts, Walters

ED 460 METHODS AND MATERIALS IN TEACHING SOCIAL STUDIES 3 (3-0) F S
Prerequisites: PSY 304, ED 344, senior standing and admission to teacher education with a major in social studies and an overall 2.0 average

A study of the purposes, methods, materials, curricula and evaluation practices appropriate for teachers of social studies at the secondary level. Mr. Thompson

ED 462 (HI 462) HISTORY OF EDUCATION 3 (3-0) S
(See history, page 337.)

ED 464 STUDENT TEACHING IN SOCIAL STUDIES 6 (2-15) F S
Prerequisites: PSY 304, ED 344, senior standing and admission to teacher education with a major in social studies and an overall 2.0 average

This course is designed to provide the prospective teacher with an opportunity to acquire experience in the techniques and skills involved in teaching social studies. Each student during the senior year will spend 10 weeks in a selected off-campus center. In addition to acquiring the competencies essential for teaching social studies, the student teacher will also have an opportunity to become familiar with the total school program and to participate in as many school and community activities as time will permit during the period of student teaching. Mr. Thompson

ED 470 METHODS OF TEACHING MATHEMATICS 3 (3-0) F S
(See mathematics and science education, page 370.)

ED 471 STUDENT TEACHING IN MATHEMATICS 6 (2-15) F S
(See mathematics and science education, page 370.)

ED 472 DEVELOPING AND SELECTING TEACHING MATERIALS IN MATHEMATICS 2 (2-0) F S
(See mathematics and science education, page 370.)

ED 475 METHODS OF TEACHING SCIENCE 3 (3-0) F
(See mathematics and science education, page 371.)

ED 476 STUDENT TEACHING IN SCIENCE 6 (2-15) F
(See mathematics and science education, page 371.)

ED 477 DEVELOPING AND SELECTING TEACHING MATERIALS IN SCIENCE 2 (2-0) F
(See mathematics and science education, page 371.)

ED 480 METHODS AND MATERIALS IN TEACHING SPEECH 3 (3-0) F S
Prerequisites: PSY 304, ED 344, senior standing and admission to teacher education with a major in speech and a 2.0 overall average

A study of the purposes, curricula, materials and methods of teaching speech, including public speaking, discussion, debate, speech improvement, oral reading and play production. Mr. Orban

ED 481 STUDENT TEACHING IN SPEECH 6 (2-15) F S
Prerequisites: PSY 304, senior standing and admission to teacher education with a major in speech and a 2.0 overall average
Corequisite: ED 480

This course is designed to provide the prospective teacher with an opportunity to acquire experience in the techniques and skills involved in teaching speech. Each student during the senior year will spend 10 weeks in a selected off-campus center. Mr. Orban

ED 482 CURRICULUM PROBLEMS IN INDUSTRIAL ARTS 2 (1-2) S
(See industrial and technical education, page 344.)

ED 483 INSTRUCTIONAL AIDS AND DEVICES 2 (1-2) F
(See industrial and technical education, page 344.)

ED 490 SENIOR SEMINAR IN AGRICULTURAL EDUCATION 1 (1-0) S
(See agricultural education, page 240.)

ED 501 (SOC 501) LEADERSHIP 3 (3-0) F S
(See sociology, page 431.)

ED 502 (PS 502) PUBLIC ADMINISTRATION 3 (3-0) F S
(See politics, page 413.)

ED 503 THE PROGRAMMING PROCESS IN ADULT EDUCATION 3 (3-0) S
(See adult and community college education, page 238.)

ED 504 PRINCIPLES AND PRACTICES OF INTRODUCTION TO VOCATIONS 3 (3-0) F S
Prerequisites: 12 hours in education

This course is designed for teachers in the public schools of North Carolina who teach Introduction to Vocations. The course emphasizes the place of the Introduction to Vocations Program in the overall school curriculum, special methods of instruction, use of teaching aids and use of student evaluation instruments. An overview is also presented in the areas of community organization, job markets, group procedures, occupational and educational information, and the changing occupational structure in our society. Staff

ED 505 PUBLIC AREA SCHOOLS 3 (3-0) F S
Prerequisite: Graduate standing

Junior and community colleges, technical institutes, vocational schools and branches of universities: their development, status and prospects; policy and policy-making, clientele, purposes, evaluation programs, personnel, organization, administration, financing, facilities, research and development functions. Staff

ED 506 EDUCATION OF EXCEPTIONAL CHILDREN 3 (3-0) F
Prerequisites: Six hours education or psychology

Discussion of principles and techniques of teaching the exceptional child with major interest on the mentally handicapped and slow learner. Practice will be given in curriculum instruction for groups of children, and individual techniques for dealing with retarded children in the average classroom. Opportunity for individual work with an exceptional child will be provided. Mrs. McCutchen

- ED 507 ANALYSIS OF READING ABILITIES 3 (3-0) F
Prerequisites: Six hours education or psychology
A study of tests and techniques in determining specific abilities; a study of reading retardation and factors underlying reading difficulties. Mr. Rust
- ED 508 IMPROVEMENT OF READING ABILITIES 3 (3-0) S
Prerequisites: Six hours education or psychology
A study of methods used in developing specific reading skills or in overcoming certain reading difficulties; a study of methods used in developing pupil vocabularies and word analysis skills; a study of how to control vocabulary burden of reading material. Mr. Rust
- ED 509 METHODS AND MATERIALS—TEACHING RETARDED CHILDREN 3 (3-0) S
Prerequisite: ED 506
Emphasis on understanding and correlating developmental levels of mentally retarded children and appropriate educational methods and materials. Use of individual child's diagnostic data; consideration of long and short range educational goals; curriculum planning in terms of realistic usefulness; scheduling; teacher guidance of children toward social and emotional maturity. Mrs. McCutchen
- ED 510 ADULT EDUCATION: HISTORY, PHILOSOPHY, CONTEMPORARY NATURE 3 (3-0) F
(See adult and community college education, page 238.)
- ED 511 IMPLICATIONS OF MATHEMATICAL CONTENT, STRUCTURE, AND PROCESSES FOR THE TEACHING OF MATHEMATICS IN THE ELEMENTARY SCHOOL 3 (3-0) F S
(See mathematics and science education, page 371.)
- ED 512 ACTIVE LEARNING APPROACHES TO TEACHING MATHEMATICS IN THE ELEMENTARY SCHOOL 3 (3-0) F S
(See mathematics and science education, page 371.)
- ED 513 (SOC 513) COMMUNITY ORGANIZATION 3 (3-0) F
(See sociology, page 433.)
- ED 516 COMMUNITY OCCUPATIONAL SURVEYS 2 (2-0) S
(See industrial and technical education, page 345.)
- ED 517 IMPLICATIONS FOR DATA PROCESSING IN EDUCATION 3 (3-0) F S
(See industrial and technical education, page 345.)
- ED 518 PRINCIPLES OF SCHOOL LAW 3 (3-0) F S
Prerequisites: Six hours graduate credit
This course will be an intensive study of the legal rights, duties, privileges and responsibilities entailed in the educational enterprise. It will cover the essentials of school law in such a way that the student will be able to obtain both a general understanding of the processes of law as they affect American education and also important specific legal aspects which affect vocational education. Included are the secondary, post-secondary and adult vocational education laws and their implications. Mr. Nerden
- ED 520 PERSONNEL AND GUIDANCE SERVICES 3 (3-0) F S
(See guidance and personnel services, page 331.)
- ED 521 INTERNSHIP IN GUIDANCE AND PERSONNEL SERVICES Credits Arranged
(See guidance and personnel services, page 331.)

ED 522 (SOC 522) SOCIAL AND VOCATIONAL ASPECTS OF SENSORY IMPAIRMENT 3 (3-0) Sum.

This course is particularly concerned with the sensory processes and impairments as these affect occupational selection and placement and social adjustment. Consideration will be given to the socialization process both of persons with congenital sensory defects and those to whom these deprivations occur later in life. Particular emphasis will be given to the visually impaired and the deaf. The multiply handicapped will be considered at length. Rehabilitation techniques and remediation procedures will be approached.

Mrs. Rawls

ED 523 ORIENTATION AND MOBILITY OF THE VISUALLY IMPAIRED 3 (3-0) Sum.

The sensory processes and sensory cues on which independent mobility depends for the visually impaired person will be discussed. Various techniques and modes of travel will be considered. Particular emphasis will be given to instruction and background which will enable persons not teaching orientation mobility as a skill to reinforce the learning that takes place in other situations. Visiting Professor

ED 524 OCCUPATIONAL INFORMATION 3 (3-0) S

(See guidance and personnel services, page 331.)

ED 525 TRADE ANALYSIS AND COURSE CONSTRUCTION 3 (3-0) F

(See industrial and technical education, page 345.)

ED 527 PHILOSOPHY OF INDUSTRIAL AND TECHNICAL EDUCATION 3 (3-0) F S

(See industrial and technical education, page 345.)

ED 529 CURRICULUM MATERIALS DEVELOPMENT 3 (3-0) S

(See industrial and technical education, page 345.)

ED 530 GROUP GUIDANCE 3 (3-0) F

(See guidance and personnel services, page 331.)

ED 531 (PSY 531) MENTAL DEFICIENCY 3 (3-0) S Sum.

Prerequisites: Nine hours psychology and special education

This will be a course in description, causation, psychological factors and sociological aspects of mental retardation. Educational methods for the mentally retarded will be examined. The course is designed primarily for school psychologists and special-class teachers of retarded children, both educable and trainable.

Mr. Corter

ED 533 ORGANIZATION AND ADMINISTRATION OF GUIDANCE SERVICES 3 (3-0) S

(See guidance and personnel services, page 331.)

ED 534 GUIDANCE IN THE ELEMENTARY SCHOOLS 3 (3-0) S

(See guidance and personnel services, page 331.)

ED 535 STUDENT PERSONNEL WORK IN HIGHER EDUCATION 3 (3-0) F S

(See guidance and personnel services, page 332.)

ED 540 INDIVIDUAL AND GROUP APPRAISAL I 3 (3-0) F

(See guidance and personnel services, page 332.)

ED 542 CONTEMPORARY APPROACHES IN THE TEACHING OF SOCIAL STUDIES 3 (3-0) F S

Prerequisites: Advanced undergraduate or graduate, must have completed student teaching

An analysis of the principles, strategies and applications of new teaching approaches. Team-teaching, programmed instruction, inductive and reflective oriented teaching, role-playing, simulation and gaming, independent study and block-time organization will be explored.

Messrs. Dolce, Thompson

ED 552 INDUSTRIAL ARTS IN THE ELEMENTARY SCHOOL 3 (3-0) Sum.
Prerequisites: 12 hours education, consent of instructor

This course is organized to help elementary teachers and principals understand how tools, materials and industrial processes may be used to vitalize and supplement the elementary school child's experiences. Practical children's projects along with the building of classroom equipment.

Staff

ED 554 PLANNING PROGRAMS IN AGRICULTURAL EDUCATION 3 (3-0) F S
(See agricultural education, page 240.)

ED 555 COMPARATIVE CRAFTS AND INDUSTRIES 6 Sum.
(See industrial and technical education, page 345.)

ED 559 PRINCIPLES OF ADULT EDUCATION 3 (3-0) F
(See adult and community college education, page 238.)

ED 560 (IA 560) NEW DEVELOPMENTS IN INDUSTRIAL ARTS EDUCATION 3 (3-0) F S
(See industrial arts, page 349.)

ED 563 EFFECTIVE TEACHING 3 (3-0) F S
Prerequisites: 12 hours education including student teaching

Analysis of the teaching-learning process; assumptions that underlie course approaches; identifying problems of importance; problem solution for effective learning; evaluation of teaching and learning; making specific plans for effective teaching.

Staff

ED 565 AGRICULTURAL OCCUPATIONS 3 (3-0) F S
(See agricultural education, page 240.)

ED 566 OCCUPATION EXPERIENCE IN AGRICULTURE 3 (3-0) S
(See agricultural education, page 240.)

ED 568 ADULT EDUCATION IN AGRICULTURE 3 (3-0) F
(See agricultural education, page 240.)

ED 590 INDIVIDUAL PROBLEMS IN GUIDANCE Maximum 6 F S
(See guidance and personnel services, page 332.)

ED 591 SPECIAL PROBLEMS IN INDUSTRIAL EDUCATION Maximum 6
(See industrial and technical education, page 345.)

ED 592 SPECIAL PROBLEMS IN MATHEMATICS TEACHING 3 (3-0) S
(See mathematics and science education, page 371.)

ED 593 SPECIAL PROBLEMS IN AGRICULTURAL EDUCATION Credits Arranged
(See agricultural education, page 240.)

ED 594 SPECIAL PROBLEMS IN SCIENCE TEACHING 3 (0-3) S
(See mathematics and science education, page 372.)

ED 595 (IA 595) INDUSTRIAL ARTS WORKSHOP (See industrial arts, page 349.)	3 (3-0) Sum.
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ED 596 TOPICAL PROBLEMS IN ADULT EDUCATION (See adult and community college education, page 239.)	Credits Arranged
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FOR GRADUATES ONLY

ED 600 THEORY OF ORGANIZATION AND ADMINISTRATION IN ADULT EDUCATION I	3 (3-0) F
ED 601 THEORY OF ORGANIZATION AND ADMINISTRATION IN ADULT EDUCATION II	3 (3-0) S
ED 602 CURRICULUM	3 (3-0) F S
ED 608 SUPERVISION OF VOCATIONAL AND INDUSTRIAL ARTS EDUCATION	3 (3-0) F
ED 609 PLANNING AND ORGANIZING TECHNICAL EDUCATION PROGRAMS	3 (3-0) F
ED 610 ADMINISTRATION OF VOCATIONAL AND INDUSTRIAL ARTS EDUCATION	3 (3-0) S
ED 611 LAWS, REGULATIONS AND POLICIES AFFECTING VOCATIONAL EDUCATION	3 (3-0) F S
ED 612 FINANCE, ACCOUNTING AND MANAGEMENT OF VOCATIONAL EDUCATION PROGRAMS	3 (3-0) F S
ED 614 MODERN PRINCIPLES AND PRACTICES IN SECONDARY EDUCATION	2 (2-0) F S
ED 615 INTRODUCTION TO EDUCATIONAL RESEARCH	3 (3-0) F S
ED 617 PHILOSOPHY OF AGRICULTURAL EDUCATION	3 (3-0) S
ED 630 PHILOSOPHY OF INDUSTRIAL ARTS	2 (2-0) F S
ED 631 VOCATIONAL DEVELOPMENT THEORY	3 (3-0) F
ED 633 TECHNIQUES OF COUNSELING	3 (3-0) F S
ED 635 ADMINISTRATION AND SUPERVISION OF INDUSTRIAL ARTS	2 (2-0) F S
ED 636 OBSERVATION AND SUPERVISED FIELD WORK	Maximum 3
ED 640 INDIVIDUAL AND GROUP APPRAISAL II	3 (3-0) F
ED 641 LABORATORY AND PRACTICUM EXPERIENCES IN COUNSELING	2-6 FS
ED 660 (IA 660) INDUSTRIAL ARTS CURRICULUM	3 (3-0) F S Sum.
ED 664 SUPERVISION IN AGRICULTURAL EDUCATION	3 (3-0) F S
ED 665 SUPERVISING STUDENT TEACHING	3 (3-0) F S
ED 666 SUPERVISION OF COUNSELING	3 (1-8) F S

ED 688	RESEARCH APPLICATION IN OCCUPATIONAL EDUCATION	3 (3-0) F S Sum.
ED 689	EVALUATION IN OCCUPATIONAL EDUCATION	3 (3-0) F S
ED 690	SEMINAR IN MATHEMATICS EDUCATION	Maximum 2 F S
ED 691	SEMINAR IN INDUSTRIAL EDUCATION	1 (1-0) F S
ED 692	SEMINAR IN INDUSTRIAL ARTS EDUCATION	1 (1-0) F S
ED 693	ADVANCED PROBLEMS IN AGRICULTURAL EDUCATION	Credits Arranged
ED 694	SEMINAR IN AGRICULTURAL EDUCATION	Maximum 2 1 (1-0) F S
ED 695	SEMINAR IN SCIENCE EDUCATION	Maximum 2
ED 696	SEMINAR IN ADULT EDUCATION	1 (1-0) F S
ED 697 (PSY 697)	ADVANCED SEMINAR IN RESEARCH DESIGN	3 (3-0) F S
ED 698	SEMINAR IN OCCUPATIONAL EDUCATION	3 (3-0) F S
ED 699	RESEARCH	Credits Arranged

ELECTRICAL ENGINEERING

FOR UNDERGRADUATES

EE 201 ELECTRIC CIRCUITS I 4 (2-5) F S
Prerequisite: MA 102

Fundamental laws of electric circuits. Introduction to transient and steady-state sinusoidal analysis. Problem drill and laboratory exercises.

EE 202 ELECTRIC CIRCUITS II 4 (2-5) S
Prerequisites: EE 201, MA 201

A continuation of EE 201. Circuit analysis by complex frequency. Introduction to two-port networks and polyphase circuits. Problem drill and laboratory exercises.

EE 211 ELECTRIC CIRCUITS I, THEORY 3 (3-0)
Prerequisite: MA 102

Theory part of EE 201. Offered only by correspondence. Enrollment subject to approval of Electrical Engineering Department Undergraduate Administrator.

EE 213 ELECTRIC CIRCUITS I, LABORATORY 1 (0-2) Sum.
Prerequisite: EE 211

Laboratory part of EE 201. Enrollment subject to approval of Electrical Engineering Department Undergraduate Administrator and limited to students who have passed EE 211.

EE 303 ELECTROMAGNETIC FIELDS I 3 (2-3) F
Prerequisites: EE 201, PY 208
Corequisite: MA 301

Basic principles of electromagnetic field theory in vector analysis formulation emphasizing static and quasi-static electric and magnetic fields. Maxwell's equations.

EE 304 ELECTROMAGNETIC FIELDS II 3 (2-3) S
Prerequisites: EE 303, MA 301

Continuation of EE 303. Vector and scalar retarded potentials. Generation and propagation of energy by electromagnetic waves. Relationship between field theory and circuit theory. Applications of electromagnetic theory to devices and to distributed parameter systems.

EE 305 ELECTROMECHANICAL SYSTEMS 4 (2-5) S
Prerequisites: EE 202, MA 202, EE 303

A classroom and laboratory study of the principles, performance and characteristics of direct-current and alternating-current machinery.

EE 314 ELECTRONIC CIRCUITS 4 (2-5) F
Prerequisites: EE 202, MA 202

A study of active devices with emphasis on bipolar and field effect transistors as elements of electric circuits. Elementary physical electronics, linear and nonlinear equivalent circuits, small signal amplifiers.

EE 331 PRINCIPLES OF ELECTRICAL ENGINEERING 3 (3-0) F S
Prerequisites: MA 201, PY 208
Not available to undergraduates in electrical engineering

An introduction to the basic concepts, units and methods of analysis of electrical engineering. Current-voltage characteristics of linear and nonlinear electrical devices, analysis of d-c and a-c circuits, simple amplifiers and energy conversion devices. Demonstrations of equipment and procedures.

EE 332 PRINCIPLES OF ELECTRICAL ENGINEERING 3 (3-0) S
Prerequisite: EE 331
Not available to undergraduates in electrical engineering

Power distribution systems, motors, feedback, amplifiers, oscilloscopes, voltmeters, digital information, measurements by digital means, presented from the user's viewpoint. Demonstrations of equipment and procedures.

EE 333 PRINCIPLES OF ELECTRICAL ENGINEERING LABORATORY 1 (0-3) S
Corequisite: EE 332

Laboratory work in the material covered in EE 332.

EE 334 ELECTRONICS AND INSTRUMENTATION 3 (3-0) S
Prerequisites: EE 202 or EE 331
Not available to undergraduates in electrical engineering

A survey of electrical and electronic circuits to provide nonelectrical engineering majors with a working understanding of electronic circuits and instruments which might be encountered in the practice of their own disciplines. Demonstrations of equipment and procedures.

EE 335 ELECTRONICS AND INSTRUMENTATION LABORATORY 1 (0-3) S
Corequisite: EE 334

Laboratory work in the material covered in EE 334.

EE 336 INDUSTRIAL POWER AND CONTROL SYSTEMS 3 (3-0) S
Prerequisite: EE 202 or EE 331

Study of applications of power generation and transformation in industry. Transformers, DC generators and motors, single-phase and polyphase motors, manual and automatic starting and control of motors with special emphasis on use of solid-state devices.

EE 337 INDUSTRIAL POWER LABORATORY 1 (0-3) S
Corequisite: EE 336

Laboratory work in the material covered in EE 336.

EE 339 PRINCIPLES OF ELECTRICAL ENGINEERING LABORATORY**1 (0-3) F S****Corequisite: EE 331**

Laboratory work in the material covered in EE 331.

EE 350 ELECTRIC POWER UTILIZATION IN MANUFACTURING PROCESSES**3 (2-3) F S****Prerequisites: PY 212, MA 201**

Not available to undergraduates in electrical engineering

Introduction to basic electrical theory; d-c and a-c circuits and measurements; study of d-c motors and of single-phase and polyphase utilization equipment; basic control systems and brief introduction to principles of automatic control. Application examples will be drawn from the technologies of particular interest to the students in the class.

FOR ADVANCED UNDERGRADUATES**EE 401 ADVANCED ELECTRIC CIRCUITS****3 (2-2) F S****Prerequisites: EE 202, MA 301**

Transient analysis of electric circuits by the Laplace transform method, and the relationship of this method of analysis to steady-state performance, with emphasis on feedback systems.

EE 403 ELECTRIC NETWORK DESIGN**3 (2-2) S****Prerequisite: EE 401**

The study of design methods for such electric networks as resonant systems, filters, feedback stabilizers, audio amplifier compensation and dividing networks.

EE 430 ESSENTIALS OF ELECTRICAL ENGINEERING**4 (3-3) F****Prerequisite: EE 202 or EE 332**

Not available to undergraduates in EE.

Essential theory of electric circuits, including solid-state devices, transformers and rotating machines as needed to supply the electrical background for instrumentation and control theory. Intended primarily for graduate students who do not have an electrical engineering undergraduate degree.

EE 431 ELECTRONICS ENGINEERING**3 (2-3) F****Prerequisite: EE 314**

Comprehensive study of circuits using discrete and integrated electron devices: amplifiers, oscillators, wave-shaping circuits, nonsinusoidal generators, feedback. Emphasis is on design of solid-state circuits through development of analytical methods using graphical, slide-rule and computer techniques.

EE 432 COMMUNICATION ENGINEERING**3 (2-3) S****Prerequisite: EE 431**

Application of electronic circuits to communication systems employing amplitude, angle and pulse modulation. Elements of complete systems: modulators, demodulators, transmitters and receivers. Introduction to information theory and noise.

EE 433 ELECTRIC POWER ENGINEERING**3 (2-3) S****Prerequisite: EE 305 or EE 332**

Electrical power supply for industrial and commercial applications; control of electrical motor drives; system safety and protection; practice in testing electrical machines.

EE 434 POWER SYSTEM ANALYSIS**3 (3-0) F****Prerequisite: EE 305**

Analysis of problems encountered in the long-distance transmission of electric power. Line parameters by the method of geometric mean distances. Circle diagrams, symmetrical components and fault calculations. Elementary concepts of power system stability. Applications of digital computers to power-system problems.

EE 435 ELEMENTS OF CONTROL**3 (2-3) F****Prerequisites:** EE 314, EE 305; or EE 430

Introductory theory of open- and closed-loop control. Functions and performance requirements of typical control systems and system components. Dynamic analysis of error detectors, amplifiers, motors, demodulators, analogue components and switching devices. Component transfer characteristics and block diagram representation.

EE 438 ELECTRONIC INSTRUMENTATION**3 (3-0) S****Prerequisites:** MA 301; EE 430 or EE 314 or EE 334

A survey of electrical-electronic measurement techniques and operating principles of electronic instruments. Includes a study of signal sources and their equivalent circuits, basic electronics including junction and field effect transistors, operational amplifiers, switching logic and data display. Applications including low-level phenomena and noise problems will be included, with many lecture demonstrations.

EE 440 FUNDAMENTALS OF DIGITAL SYSTEMS**3 (3-0) F S****Prerequisite:** EE 314 or EE 430

The basic theory of digital computation and control. Introduction to number systems, data handling, relay algebra, switching logic, memory circuits, the application of electronic devices to switching circuits, and the design of computer control circuits.

EE 441 INTRODUCTION TO ELECTRON DEVICES**3 (3-0) F****Prerequisites:** MA 301; PY 207 or PY 208

A study of the basic physical principles necessary for understanding modern electronic devices. Quantum and statistical mechanic concepts are introduced at an elementary level, and these ideas form the basis for a discussion of a wide variety of devices which are used in modern engineering and instrumentation.

EE 442 INTRODUCTION TO SOLID-STATE DEVICES**3 (3-0) S****Prerequisites:** EE 441 or PY 407; MA 301

An introduction to the microscopic phenomena responsible for the operation of solid-state electronic devices. A qualitative description of the band model of solids is followed by a description of the transport properties of charge carriers. P-n junction diodes and transistors, solar cells, controlled rectifiers, tunnel diodes and unijunction transistors are treated along with more recently developed devices.

EE 445 INTRODUCTION TO ANTENNAS**3 (2-3) F****Prerequisites:** EE 304, EE 314

An introduction to antenna engineering. Consideration will be given to radiation from single-element radiators, radiation patterns, directive properties aperture concepts, gain and impedances. Multielement antennas and arrays with various amplitude distributions and phasings, and thin linear antennas will be treated in some detail. Antennas of current usage.

EE 448 INTRODUCTION TO MICROWAVES**3 (2-3) S****Prerequisites:** EE 304, EE 314

A study of the elementary theory and special techniques required at microwave frequencies. Both passive and active circuits will be considered. Transmission elements, special-purpose components, generators, to include klystrons, magnetrons, traveling wave tubes, and solid-state devices will be discussed. The description of microwave networks by the scattering matrix will be presented.

FOR GRADUATES AND ADVANCED UNDERGRADUATES**EE 503 COMPUTER-AIDED CIRCUIT ANALYSIS****3 (3-0) F****Prerequisites:** EE 314, EE 401, B average in electrical engineering and mathematics

Analysis of electrical circuits with emphasis on computer methods. Steady-state and transient analysis of linear and nonlinear networks; tolerance analysis; programming considerations. Mr. Staudhammer

EE 504 INTRODUCTION TO NETWORK SYNTHESIS 3 (3-0) S
Prerequisites: EE 401, B average in electrical engineering and mathematics

A study of the properties of network functions and the development of the methods of network synthesis of one-port and two-port passive structures. Mr. Stevenson

EE 506 DYNAMICAL SYSTEMS ANALYSIS 3 (3-0) F
Prerequisites: EE 202 or EE 331; EM 301; MA 301; B average in electrical engineering, engineering mechanics and mathematics

A study of dynamic systems in various branches of engineering and science with emphasis on the similarities that exist among such integrated groups of devices. Analogous elements and quantities in these fields as determined from equations basic to each. Analytical formulation of system problems in accoustical, electrical, mechanical and related fields and their solution by analog methods. Use of computers for the solution of system problems. Mr. Eckels

EE 511 ELECTRONIC CIRCUITS 3 (3-0) F
Prerequisites: EE 314 or EE 430, B average in electrical engineering and mathematics

Electronic devices in amplifiers, feedback systems, oscillators, modulators, switching and wave-shaping circuits. Generation of nonlinear waveforms; electronic instruments; circuits basic to electronic computers. Use of complex frequency concepts to obtain generalized response. Communications, power and industrial applications. Synthesis of circuits to satisfy system requirements. Mr. Barclay

EE 512 COMMUNICATION THEORY 3 (3-0) F
Prerequisites: EE 314, B average in electrical engineering and mathematics

Material basic to information-bearing signals in linear systems. Signals in the frequency and time domains, probability and associated functions, random signal theory, modulation and frequency translation, noise, sampling theory and correlation functions. Principles of information theory including information measure, signal space and channel capacity. Fundamentals of encoding. Accent on methods and problems unique to the field of digital communication. (Offered fall every year and summer, 1972.) Mr. Barclay

EE 516 FEEDBACK CONTROL SYSTEMS 3 (3-0) S
Prerequisites: EE 435, or EE 401 and B average in electrical engineering and mathematics

Study of feedback systems for automatic control of physical quantities such as voltage, speed and mechanical position. Theory of regulating systems and servomechanisms. Steady-state and transient responses. Evaluation of stability. Transfer function loci and root locus plots. Analysis using differential equation and operational methods. System compensation and introduction to design. Mr. Peterson

EE 517 CONTROL LABORATORY 1 (0-3) S
Corequisite: EE 516

Laboratory study of feedback systems for automatic control of physical quantities such as voltage, speed and mechanical position. Characteristics of regulating systems and servomechanisms. The laboratory work is intended to contribute to an understanding of the theory developed in EE 516. Mr. Peterson

EE 520 FUNDAMENTALS OF LOGIC SYSTEMS 3 (3-0) F
Prerequisites: EE 314 or EE 430, B average in electrical engineering and mathematics

A study of elementary machine language theory, computer organization and logical design, logical algebras and function minimization (map method emphasized). Introductory combinational and sequential logic including circuits, basic

building blocks, and theory construction using electronic and core elements.
(Offered fall every year and spring, 1972.) Mr. Bell

EE 521 DIGITAL COMPUTER TECHNOLOGY AND DESIGN 3 (3-0) S

Prerequisite: EE 520

A study of the internal organization and structure of digital systems including gates, toggle circuits, pulse circuitry and advanced machine language theory. Analysis and synthesis of the major components of computers, including the logic section, counters, storage devices, registers, input-output and control.
Messrs. Bell, Patt

EE 530 PHYSICAL ELECTRONICS 3 (3-0) F

Prerequisites: EE 304, B average in electrical engineering and mathematics

A study of behavior of charged particles under the influence of fields and other charged particles. Ballistics, quantum mechanics, particle statistics, electron emission and properties of dielectric and magnetic materials. (Offered fall every year, spring, 1971 and summer, 1973.)
Mr. Matthews

EE 533 INTEGRATED CIRCUITS 3 (3-0) S

Prerequisites: EE 314, B average in electrical engineering and mathematics

A study of the implementation of solid-state circuits in integrated form. Includes characteristics of epitaxial, diffused, thin and thick film approaches. Digital and linear applications are examined.
Mr. Manning

EE 535 (MAE 535) GAS LASERS 3 (3-0) S

(See mechanical and aerospace engineering, page 377.)

EE 540 ELECTROMAGNETIC FIELDS AND WAVES 3 (3-0) F

Prerequisites: EE 304, B average in electrical engineering and mathematics

Laws and concepts of static electromagnetism. Fundamental equations and their applications. Fundamentals, forms and applications of Maxwell's equations. Vector and scalar potentials, relativistic aspects of fields, energy and power. Waves in unbounded and bounded regions, radiation, waveguides and resonators. (Offered fall every year, summer, 1971 and spring, 1973.)
Mr. Tischer

EE 545 INTRODUCTION TO RADIO WAVE PROPAGATION 3 (3-0) S

Prerequisites: EE 304, B average in electrical engineering and mathematics

Characteristics of plane electromagnetic waves in homogeneous and nonhomogeneous media with application to tropospheric and ionospheric propagation. Relationships between electron density, collision frequency and complex refractive index, theory of the formation and dynamics of ionospheric layers and theorems for the prediction of ionospheric propagation.
Mr. Flood

EE 591, 592 SPECIAL TOPICS IN ELECTRICAL ENGINEERING 3 (3-0) F S

Prerequisite: B average in technical subjects

A two-semester sequence to develop new courses and to allow qualified students to explore areas of special interest.
Graduate Staff

EE 593 INDIVIDUAL TOPICS IN ELECTRICAL ENGINEERING 1-3 F S

Prerequisite: B average in technical subjects

A course providing an opportunity for individual students to explore topics of special interest under the direction of a member of the faculty.

FOR GRADUATES ONLY

EE 610 NON-LINEAR ANALYSIS 3 (3-0) F

EE 611, 612 ELECTRIC NETWORK SYNTHESIS 3 (3-0) F S

EE 613, 614 ADVANCED FEEDBACK CONTROL 3 (3-0) F S

EE 616	MICROWAVE ELECTRONICS	3 (3-0) S
EE 617	PULSE AND DIGITAL CIRCUITS	3 (3-0) S
EE 618	ANTENNAS AND RADIATION	3 (3-0) F
EE 619	GUIDED WAVES AND RESONATORS	3 (3-0) S
EE 622	ELECTRONIC PROPERTIES OF SOLID-STATE MATERIALS I	3 (3-0) S
EE 623	ELECTRONIC PROPERTIES OF SOLID-STATE MATERIALS II	3 (3-0) F
EE 624	ELECTRONIC PROPERTIES OF SOLID-STATE DEVICES	3 (3-0) S
EE 625	ADVANCED SOLID-STATE DEVICE THEORY	3 (3-0) F
EE 640	ADVANCED LOGIC CIRCUITS	3 (3-0) S
EE 641	SEQUENTIAL MACHINES	3 (3-0) F
EE 642	AUTOMATA AND ADAPTIVE SYSTEMS	3 (3-0) S
EE 643	ADVANCED ELECTRICAL MEASUREMENTS	3 (3-0) Sum.
EE 651	STATISTICAL COMMUNICATION THEORY	3 (3-0) S
EE 652	INFORMATION THEORY	3 (3-0) F
EE 653	FUNDAMENTALS OF SPACE COMMUNICATIONS	3 (3-0) S
EE 654	COMMUNICATION SYSTEMS ANALYSIS	3 (3-0) S
EE 655	WAVE PHENOMENA IN PLASMA	3 (3-0) S
EE 659	PATTERN RECOGNITION	3 (3-0) F
EE 691, 692	SPECIAL STUDIES IN ELECTRICAL ENGINEERING	3 (3-0) F S
EE 695	ELECTRICAL ENGINEERING SEMINAR	1 (1-0) F S
EE 699	ELECTRICAL ENGINEERING RESEARCH	Credits Arranged

ENGINEERING (General Courses)

E 101	ENGINEERING GRAPHICS I	2 (1-2) F S
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The theory of graphically representing and solving spatial problems. Emphasis is placed on the development of a logical and analytical approach to problem solution. Conventional methods of graphically describing size and shape are presented and the representation of basic mechanical elements is introduced. Practical engineering applications are utilized. Staff

E 120	ENGINEERING CONCEPTS	3 (2-1) F S
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An introduction to engineering concepts by student involvement in realistic freshman design projects. The history, fields and functions of engineering, computational skills, societal problems and case studies will be covered. Staff

E 207	ENGINEERING GRAPHICS III	2 (1-3) F S
Prerequisite: E 101		

A more exact presentation of engineering data in the graphical medium. Production dimensioning, production characteristics of various types, free-hand sketching, production changes, and detail and assembly drawings will be covered. Special emphasis will be placed upon the use of freehand technical sketching in the communication of engineering data. Staff

E 240 FURNITURE GRAPHICS

3 (1-4) F

Prerequisite: E 101

Provides the student with an understanding of furniture drawing and its dimensioning. Special conventions applying to the furniture industry are covered. Freehand sketching is emphasized.

Mr. Kelly

E 492 SPECIAL TOPICS IN ENGINEERING

1-3 F S

Prerequisite: Junior standing

A course offered as needed to cover special subject matter of a nondepartmental nature.

Staff

ENGINEERING HONORS

EH 345 SOLID MECHANICS

3 (3-0) F S

Prerequisites: EM 200; for members of the engineering honors program or consent of instructor

Introduction to the behavior of deformable solids. Development of relationships among loads, stresses, strains and displacements. Mathematical representation and analysis of the behavior of shells, beams, shafts, columns, etc.

EH 346 FLUID MECHANICS

3 (3-0) S

Prerequisites: EM 200; for members of the engineering honors program or consent of instructor

Study of the concepts and principles relating to fluid mechanics. Equilibrium of liquids and gases, kinematics and dynamics of frictionless fluids. Motion of viscous fluids. Dynamics of gases. Flow measurement techniques.

EH 371 THERMODYNAMICS I

3 (3-0) F

Prerequisite: For members of the engineering honors program or consent of instructor

A study of the basic principles and concepts of thermodynamics. Particular emphasis is placed on first and second laws, their implications and applications. The properties of actual and real gases are investigated and also the interrelationships between the properties as given by the general equations of thermodynamics.

EH 372 THERMODYNAMICS II

3 (3-0) S

Prerequisites: EH 371; for members of the engineering honors program or consent of instructor

The statistical approach to thermodynamics and the application to determination of specific heats. Entropy and probability. The thermodynamics of fluid flow including supersonic flow. The basic laws of heat transfer. Ideal gas and vapor cycles. Introduction to chemical thermodynamics.

EH 395 CONTEMPORARY TRENDS IN ENGINEERING AND SCIENCE

1 (1-0) F

Prerequisite: For members of engineering honors program or consent of instructor

Representatives from various fields of engineering or science discuss topics of current significance in their areas of interests.

EH 401 SPECIAL TOPICS IN ENGINEERING

1-4 F S

Prerequisite: For members of the engineering honors program or consent of instructor

Special projects in various phases of engineering, either of a research or design nature.

EH 495 ENGINEERING HONORS SEMINAR

1 (0-1) S

Prerequisite: For seniors in the engineering honors program or consent of instructor

Individual presentation by the students of their projects conducted in connection with the honors program.

This is an engineering "case method" experience, making use of the principles of engineering, physics and mathematics. Professors in engineering and certain key individuals from industry will work singly with the professor in charge to introduce challenging engineering situations and to stimulate student analysis.

ENGINEERING MECHANICS

FOR UNDERGRADUATES

EM 200 INTRODUCTION TO MECHANICS

3 (3-0) F S

Corequisite: MA 301

An introduction to the principles and concepts which form the basis for studies in dynamics, solid mechanics and fluid mechanics. The nature and properties of force systems and stress fields. The motion of particles and description of deformation of continuous media. The role of Newton's laws, the concepts of continuity and equilibrium, and the conservational principles in problems in mechanics. Staff

EM 205 PRINCIPLES OF ENGINEERING MECHANICS

3 (3-0) F S

Prerequisite: PY 205

Corequisite: MA 202

Basic concepts, forces and equilibrium, distributed forces, virtual work, and inertial properties; application to mechanics, structures and systems. Staff

EM 206 INTRODUCTORY APPLICATIONS IN MECHANICS

1 (0-2) F

Corequisite: EM 205

Principles of mechanics applied to practical problems of engineering science in which numerical techniques of computation are emphasized. Staff

EM 211 INTRODUCTION TO APPLIED MECHANICS

3 (3-0) F S

Corequisites: MA 212, PY 212

This course is intended to acquaint the student with the concepts of particle and rigid body mechanics. The fundamentals of equilibrium, kinematics and kinetics are applied to engineering problems involving structures and machines. Staff

EM 212 MECHANICS OF ENGINEERING MATERIALS

3 (2-1) F S

Prerequisite: EM 211

This course constitutes a study of the properties of engineering materials with special emphasis on the mechanical parameters. It is especially conceived to prepare the student for the selection and specification of materials common to engineering practice. A particular emphasis is given to mechanical aspects of materials employed in design. Staff

EM 301 SOLID MECHANICS I

3 (3-0) F S

Prerequisite: EM 200

Introduction to the mechanics of deformable solids. Development of the equations which describe the linear elastic solid. Approximate solutions and solutions governed by the theory of elasticity to problems involving prescribed force systems, states of motion or energy inputs. Staff

EM 302 SOLID MECHANICS II

3 (3-0) F S

Prerequisite: EM 301

Continuation of EM 301. Equations for thin plates. Introduction to the theory of plasticity. Theories of yielding, plastic stress-strain relationships and two-dimensional problems in plastic behavior. Staff

EM 303 FLUID MECHANICS I 3 (3-0) F S
Prerequisite: EM 200 or EM 205

Development of the basic equations of fluid mechanics in general and specialized form. Application of these specialized equations to a variety of topics including (1) fluid statics, (2) inviscid, incompressible fluid flow and (3) viscous, incompressible fluid flow. Staff

EM 304 FLUID MECHANICS II 3 (3-0) F S
Prerequisite: EM 303

Continuation of EM 303. Further applications of the basic equations of fluid mechanics to (1) boundary layers and analysis, (2) laminar and turbulent flows and (3) compressible fluid flow. Introduction to experimental methods in fluid mechanics. Staff

EM 305 ENGINEERING DYNAMICS 3 (3-0) F S
Prerequisite: EM 205
Corequisite: MA 301

Equations of motion; kinematics, kinetics of mass points and systems of mass points; kinematics and kinetics of rigid bodies; dynamics of nonrigid systems. Staff

EM 307 MECHANICS OF SOLIDS 3 (3-0) F S
Prerequisite: EM 205
Corequisite: MA 301

Stresses, strains, constitutive laws, yield and fracture; application to axial, bending, torsional and plane stress states; deflection and stability analyses. Staff

EM 311 EXPERIMENTAL ENGINEERING SCIENCE I 3 (1-6) F
Corequisites: EM 303, EM 307

A course which deals from the outset with the experimental analysis concept starting with question of how observations and measurements are made. Illustrations follow of experimental methods which enable the inference of one physical variable by the observation of another but related one. Mr. Bingham

EM 312 EXPERIMENTAL ENGINEERING SCIENCE II 3 (1-6) S
Prerequisite: EM 311

The background in EM 311 is utilized in the study of broader problems which require the synthesis from several experimental methods as well as mathematical and/or numerical methods of an analytical system. Mr. Bingham

EM 411, 412 ENGINEERING CYBERNETICS I, II 3 (1-4) F S
Prerequisite: Senior standing in engineering mechanics or equivalent background

A year course to provide a forum for formal lectures on a range of common topics which would include, among others, the subjects of dynamics of linear and nonlinear systems; hereditary and feedback couplings; continuous, discrete, random and stochastic inputs; system stability; reliability; optimization; and the ultrastable autonomous system. A principal feature is student participation, in either individual or collective form, in extra-class work of personal character in the design of particular engineering systems. Mr. McDonald

EM 415 ENGINEERING SCIENCE IN CONTEMPORARY DESIGN 2 (1-3) S
Prerequisite: Senior standing in engineering mechanics

A course in which, drawing upon the student's background in engineering sciences, current problems are analyzed. Case histories and evaluations of selected designs are discussed. Mr. Douglas

FOR GRADUATES AND ADVANCED UNDERGRADUATES

EM 501, 502 CONTINUUM MECHANICS I, II 3 (3-0) F S
Prerequisites: EM 301, EM 303, MAE 301, MA 405

The concepts of stress and strain are presented in generalized tensor form. Emphasis is placed on the discussion and relative comparison of the analytical models for elastic, plastic, fluid, viscoelastic, granular and porous media. The underlying thermodynamic principles are presented, the associated boundary value problems are formulated and selected examples are used to illustrate the theory.

Mr. T. S. Chang

EM 503 THEORY OF ELASTICITY I

3 (3-0) F

Prerequisite: EM 301

Corequisite: MA 511 or MA 401

The fundamental equations governing the behavior of an elastic solid are developed in various curvilinear coordinate systems. Plane problems, as well as the St. Venant problem of bending, torsion and extension of bars are covered. Displacement fields, stress fields, Airy and complex stress functions are among the methods used to obtain solutions.

Messrs. Douglas, Ely, T. E. Smith

EM 504 MECHANICS OF IDEAL FLUIDS

3 (3-0) F

Prerequisite: EM 304

Corequisite: MA 513

Basic equations of ideal fluid flow; potential and stream functions; vortex dynamics; body forces due to flow fields, methods of singularities in two-dimensional flows; analytical determination of potential functions; conformal transformations; free-streamline flows.

Messrs. C. M. Chang, Edwards, Sorrell

EM 505 MECHANICS OF VISCOUS FLUIDS I

3 (3-0) S

Prerequisite: EM 304

Corequisite: MA 532

Equations of motion of a viscous fluid (Navier-Stokes equations); general properties of the Navier-Stokes equations; some exact solutions of the Navier-Stokes equations; boundary layer equations; some approximate methods of solution of the boundary layer equations; laminar boundary layers in axisymmetric and three-dimensional flows; unsteady laminar boundary layers.

Messrs. C. M. Chang, Sorrell

EM 506 MECHANICS OF COMPRESSIBLE FLUIDS I

3 (3-0) F

Prerequisites: EM 304, MAE 302

Corequisite: MA 532

Introduction to the flow of a compressible fluid: thermodynamics and one-dimensional energy equation for a compressible gas. Acoustics, normal shock waves and expansion waves, shock tube theory, general one-dimensional flow and flow in ducts and channels.

Messrs. C. M. Chang, Sorrell

EM 507 SYSTEMS ANALYSIS

3 (3-0) F

Prerequisites: EM 301, EM 303, MA 511

A course in the design of engineering systems in which mechanics dominates.

Mr. McDonald

EM 508 SYSTEMS SYNTHESIS

3 (3-0) S

Prerequisite: EM 507

A course in the design of engineering systems in which mechanics dominates.

Mr. McDonald

EM 509 SPACE MECHANICS I

3 (3-0) F

Prerequisites: EM 302, EM 304

Corequisite: MA 511

The application of mechanics to the analysis and design of orbits and trajectories. Trajectory computation and optimization; space maneuvers; reentry trajectories; interplanetary guidance.

Messrs. Clayton, Maday

EM 510 SPACE MECHANICS II

3 (3-0) S

Prerequisites: EM 509, MA 511

Continuation of EM 509. The analysis and design of guidance systems. Basic

sensing devices; the characteristics of an inertial space; the theory of stabilized platforms; terrestrial inertial guidance. Messrs. Clayton, Maday

EM 511 THEORY OF PLATES AND SHELLS

3 (3-0) F

Prerequisites: EM 301, MA 511

Bending theory of thin plates; geometry of surfaces and stresses in shells. Various methods of analysis are discussed and illustrated by problems of practical interest. Messrs. Bingham, Clayton, Gurley

EM 521 PROPERTIES OF SOLIDS

3 (3-0) F

Prerequisites: EM 301, MAT 201, PY 407

Atomic and molecular principles are applied toward an introductory understanding of macroscopic material properties. The concept of the grand canonical ensemble average of atomic behavior is employed to unify the characterization and interrelationships of material properties. Finally, phenomenological behaviors and coupled effects are described within the continuum concept. Mr. Horie

EM 551 ADVANCED STRENGTH OF MATERIALS

3 (3-0) F

Prerequisite: EM 301

Stresses and strains at a point; rosette analysis; stress theories, stress concentration and fatigue; plasticity; inelastic, composite and curved beams; prestress energy methods; shear deflections; buckling problems and column design; and membrane stresses in shells. Mr. Gurley

EM 552 ELASTIC STABILITY

3 (3-0) S

Prerequisites: EM 551, MA 301, MA 405

A study of elastic and plastic stability. The stability criterion as a determinant. The energy method and the theorem of stationary potential energy. The solution of buckling problems by finite differences and the calculus of variations. The application of successive approximations to stability problems. Optimization applied to problems of aeroelastic and civil engineering structures. Mr. Gurley

EM 555 DYNAMICS I

3 (3-0) F

Prerequisites: EM 301, MA 405

The theory of vibrations from the Lagrangian formulation of the equations of motion. Free and forced vibrations with and without damping, multiple degrees of freedom, coupled motion, normal mode vibrations, wave propagations in solid bodies. Messrs. Clayton, Maday

EM 556 DYNAMICS II

3 (3-0) S

Prerequisites: EM 301, MA 405

The dynamics of particles and rigid bodies by the use of formulations of the laws of mechanics due to Newton, Euler, Lagrange and Hamilton. Accelerated reference frames, constraints, Euler's angles, the spinning top, the gyroscope, precession, stability, phase space and nonlinear oscillatory motion. Messrs. Clayton, Maday

EM 590 (PHI 590, REL 590) TECHNOLOGY AND HUMAN VALUES

3 (3-0) F S

Prerequisites: A baccalaureate degree in engineering, liberal arts, science or social science; or, for advanced undergraduates, two or more courses such as HI 341, SS 301, 302, SS 401, or six hours in philosophy

An exploration from two or more disciplinary perspectives (notably those of ethical theory and cybernetic information theory) the range of ways of conceptualizing the relationship between the technologies of a society and the values of that society, and in areas of particular interest to students, a detailed analysis of contemporary instances of the interrelation of technology and human values. Messrs. McDonald, Shriver

FOR GRADUATES ONLY

EM 601, 602 UNIFYING CONCEPTS IN MECHANICS I, II

3 (3-0) F S

EM 603	THEORY OF ELASTICITY II	3 (3-0) S
EM 604	THEORY OF PLASTICITY	3 (3-0) S
EM 605, 606 (MAS 605, 606, OY 605, 606)	ADVANCED GEOPHYSICAL FLUID MECHANICS I, II	3 (3-0) F S
EM 611	MECHANICS OF COMPRESSIBLE FLUIDS II	3 (3-0) S
EM 612	MECHANICS OF VISCOUS FLUIDS II	3 (3-0) F
EM 613, 614 (MAS 613, 614, OY 613, 614)	PERTURBATION METHOD IN FLUID MECHANICS I, II	3 (3-0) F S
EM 621	PROPERTIES OF MATERIALS AT LOW TEMPERATURES	3 (3-0) S
EM 631 (OR 631)	VARIATIONAL METHODS IN OPTIMIZATION TECHNIQUES I	3 (3-0) F
EM 632 (OR 632)	VARIATIONAL METHODS IN OPTIMIZATION TECHNIQUES II	3 (3-0) S
EM 641	OPTICAL MECHANICS	3 (2-3) F
EM 656	NONLINEAR VIBRATIONS	3 (3-0) S
EM 695	EXPERIMENTAL METHODS IN MECHANICS	3 (2-3) S
EM 697	SEMINARS IN MECHANICS	1 (1-0) F S
EM 698	SPECIAL TOPICS IN MECHANICS	Credits Arranged F S
EM 699	RESEARCH IN MECHANICS	Credits Arranged F S

ENGINEERING OPERATIONS

EO 491	SEMINAR IN ENGINEERING OPERATIONS	1 (1-0)
Prerequisite: Senior standing		

A seminar for engineering operations seniors to assist the transition from a college environment to that of industry; lectures, problems, presentation of papers and outside speakers.

ENGLISH

(Also see Speech)

FRESHMAN ENGLISH Required of all Freshmen

ENG 111	COMPOSITION AND RHETORIC	3 (3-0) FS
Intensive study and practice in the basic forms and principles of expository communication; conferences. Staff		
ENG 112	COMPOSITION AND READING	3 (3-0) FS
Prerequisite: ENG 111		
Continued practice in expository writing; introduction to literary types; collateral reading; conferences. Staff		

NOTE: Qualified students will be allowed to register for ENG 112H and will be given credit for 111 upon successful completion of the course. Eligibility for

112H is based on the student's predicted grade in English, employing a formula determined by Counseling, plus a composition to be written at the first or second class meeting of the 112H section.

NOTE: The prerequisite for all advanced courses in writing, language, speech, or literature is the completion of ENG 111 and ENG 112 with a grade of C or better in at least one semester. Desirable preparation for literature courses of the 300 level or above is ENG 205 or any semester of ENG 261, ENG 262 or ENG 265, ENG 266.

WRITING

FOR UNDERGRADUATES

ENG 200 WRITING LABORATORY 0 (0-3) F S

A three-hour noncredit remedial course in composition designed for upperclassmen, chiefly juniors and seniors, who in any curriculum may be found deficient in composition. Mr. Easley

ENG 215 PRINCIPLES OF NEWS AND ARTICLE WRITING 3 (3-0) FS

Introduction to the writing of news articles. Mrs. Bradley

ENG 321 THE COMMUNICATION OF TECHNICAL INFORMATION 3 (3-0) FS

Intensive training in the fundamentals of business and industrial expository and persuasive writing. Messrs. Dandridge, Davis, Heaton

ENG 322 ADVANCED EXPOSITORY WRITING 3 (3-0) F

A course for upperclassmen designed to examine the rhetoric of the sentence, the paragraph and the whole discourse in order to develop awareness of the relationship between structure and effect in expository writing. A section designated ENG 322H is restricted to Teacher Certification English majors. Messrs. Dandridge, Meyers

ENG 323 CREATIVE WRITING 3 (3-0) F

Especially designed for students who have demonstrated ability; emphasis on short prose fiction. Mr. Owen

LITERATURE

FOR UNDERGRADUATES

ENG 205 READING FOR DISCOVERY 3 (3-0) F S

Selected masterworks drawn from American, English and European literature. Staff

ENG 261 ENGLISH LITERATURE I (Beginnings to 1790) 3 (3-0) F S
Staff

ENG 262 ENGLISH LITERATURE II (1790 to present) 3 (3-0) F S
Staff

ENG 265 AMERICAN LITERATURE I (Beginnings to 1850) 3 (3-0) F S
Staff

ENG 266 AMERICAN LITERATURE II (1850 to present) 3 (3-0) F S
Staff

- ENG 346 COMPARATIVE LITERATURE I 3 (3-0) F S
Selected great books ranging from the earliest Hebraic and Greek literature to the beginnings of the Renaissance. Mr. Smith, Mrs. Smoot
- ENG 347 COMPARATIVE LITERATURE II 3 (3-0) S
Masterworks of Continental literature from the Renaissance to 1900. Mrs. Smoot
- ENG 369 AMERICAN NOVEL OF THE 19TH CENTURY 3 (3-0) S
Analysis of selected romantic, realistic and naturalistic novels. Messrs. Clark, Heaton, West
- ENG 370 THE BRITISH NOVEL OF THE 18TH AND 19TH CENTURIES 3 (3-0) F
A study of the background of the English novel from its beginnings to the end of the 19th century, and an analysis of the novel as a form. Miss C. Moore, Mr. F. Moore
- ENG 371 THE MODERN NOVEL 3 (3-0) S
A study of the background and patterns, and an analysis of major examples of the 20th century novel. Miss C. Moore, Messrs. Halperen, Reynolds
- ENG 372 MODERN POETRY 3 (3-0) S
An introductory course with the objective of defining the "modern temper" by comparison of contemporary poetry with that of the past. Reading and analysis of individual poems. Messrs. Lasseter, Owen
- ENG 382 SHORT PROSE FICTION 3 (3-0) S
Contemporary British and American short stories. (Offered in alternate years.) Mr. Kincheloe
- ENG 395 BLACK AMERICAN LITERATURE 3 (3-0) F S
A survey of Black American literature from significant beginnings to the present. Mr. Barrax
- ENG 397 LITERATURE OF THE NON-WESTERN WORLD 3 (3-0) F
Selected translations from the literature of Persia, India, China and Japan. (Offered in alternate years.) Mr. Owen
- ENG 398 CONTEMPORARY LITERATURE I (1900 to 1940) 3 (3-0) F
A study of a broad range of imaginative literature from the period 1900-1940 with emphasis upon themes and techniques rather than genre or nationality. Messrs. Knowles, Reynolds
- ENG 399 CONTEMPORARY LITERATURE II (1940 to present) 3 (3-0) S
The study of representative French, American and British writers of the period 1940 to the present. Messrs. Knowles, Reynolds
- ENG 439 17TH-CENTURY ENGLISH LITERATURE 3 (3-0) S
An examination of the major nondramatic literary figures in England during the period 1600-1700. Messrs. Blank, White
- ENG 449 THE RENAISSANCE 3 (3-0) F
A study of nondramatic prose and poetry of the 16th century, with consideration of literary types and movements, and with special emphasis on the works of major authors. Messrs. Blank, F. Moore
- ENG 451 CHAUCER 3 (3-0) F S
An undergraduate introduction to the study of Chaucer through an intensive reading of his masterpieces, *The Canterbury Tales* and *Troilus and Criseyde*. Messrs. Koonce, Toole

ENG 453 THE ROMANTIC PERIOD 3 (3-0) F
 The poetry of Wordsworth, Coleridge, Byron, Shelley and Keats, with readings in the prose of Lamb, DeQuincey and others.
 Messrs. Hargrave, P. Williams

ENG 463 THE VICTORIAN PERIOD 3 (3-0) S
 Major poets and selected prose writers studied against the social, economic, scientific and theological background of the century.
 Messrs. Hargrave, Lasseter

ENG 468 AMERICAN ROMANTICISM 3 (3-0) F
 A study of major American writers from 1825 to 1865.
 Messrs. Kincheloe, Scoville, Stein, West

ENG 469 AMERICAN REALISM AND NATURALISM 3 (3-0) S
 A study of major American writers from 1865 to 1935.
 Messrs. Kincheloe, Scoville, Stein, West

ENG 480 MODERN DRAMA 3 (3-0) F
 Major plays from Ibsen to Albee.
 Mr. Halperen

ENG 485 SHAKESPEARE 3 (3-0) F S
 A study of the principal plays with emphasis on the development of the playwright.
 Messrs. Champion, Hartley, Toole, P. Williams

ENG 496 LITERARY ANALYSIS (SENIOR SEMINAR) 3 (3-0) S
 Prerequisite: Consent of department

A flexible course in reading and criticism designed to synthesize some aspect of the student's preceding work in literature and to provide a capstone for his undergraduate program. A section designated ENG 496H, restricted to Teacher Certification English majors, will be offered each semester.
 Staff

ENG 498 SPECIAL TOPICS IN ENGLISH 1-6 F S
 Prerequisite: Six hours of English above the freshman level

A detailed investigation of a special topic in language or literature, the topic and mode of study to be determined by the faculty member in consultation with the head of the English department.
 Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ENG 504 PROBLEMS IN COLLEGE COMPOSITION 3 (3-0) F
 Prerequisite: Graduate standing or consent of instructor

Directed study of the development of rhetorical skills in composition in classroom situations. Enrollment restricted to graduate assistants.
 Messrs. Betts, Walters

ENG 524 MODERN ENGLISH USAGE 3 (3-0) S
 Prerequisite: Graduate standing or consent of instructor

An intensive study of English grammar, with attention to new developments in structural linguistics and with emphasis on current usage. Messrs. Meyers, Short

ENG 526 HISTORY OF THE ENGLISH LANGUAGE 3 (3-0) FS
 Prerequisite: Graduate standing or consent of instructor

A survey of the growth and development of the language from its Indo-European beginnings to the present.
 Messrs. Meyers, Short

ENG 561	MILTON	3 (3-0) S
Prerequisite: ENG 261 or equivalent		
An intensive reading of Milton with attention to background materials in the history and culture of 17th-century England. Messrs. Blank, F. Moore		
ENG 562	THE 18TH CENTURY	3 (3-0) F
Prerequisite: ENG 261 or equivalent		
The major figures in English literature between 1660 and 1790 against the background of social, cultural and religious change. Messrs. Hartley, F. Moore, White		
ENG 575	SOUTHERN WRITERS	3 (3-0) S
Prerequisite: ENG 266 or equivalent		
A survey of the particular contribution of the South to American literature, with intensive study of selected major figures. Messrs. Clark, Kincheloe, West		
ENG 578	ENGLISH DRAMA TO 1642	3 (3-0) F
Prerequisite: ENG 261 or equivalent		
Intensive study of the English drama from the beginnings to 1642. Messrs. Champion, Meyers		
ENG 579	ENGLISH DRAMA OF THE RESTORATION AND 18TH CENTURY	3 (3-0) S
Prerequisite: ENG 261 or equivalent		
Intensive study of the English drama from 1660 to 1800. Messrs. F. Moore, White		
ENG 590	LITERARY CRITICISM	3 (3-0) S
Prerequisite: ENG 261 or equivalent		
An examination of the critical process as it leads to the definition and analysis of literature, together with attention to the main literary traditions and conventions. Messrs. Halperen, P. Williams		

FOR GRADUATES ONLY

ENG 608	BIBLIOGRAPHY AND METHODOLOGY	3 (3-0) F
ENG 610	MIDDLE ENGLISH LITERATURE	3 (3-0) F
ENG 615	AMERICAN LITERATURE OF THE COLONIAL PERIOD	3 (3-0) F
ENG 620	16TH-CENTURY NON-DRAMATIC ENGLISH LITERATURE	3 (3-0) F
ENG 630	17TH-CENTURY ENGLISH LITERATURE	3 (3-0) S
ENG 650	19TH-CENTURY ENGLISH LITERATURE: THE ROMANTIC PERIOD	3(3-0) F
ENG 651	STUDIES IN CHAUCER	3 (3-0) F
ENG 655	19TH-CENTURY AMERICAN LITERATURE: THE ROMANTIC PERIOD	3 (3-0) F
ENG 658	STUDIES IN SHAKESPEARE: THE TRAGEDIES	3 (3-0) F
ENG 659	STUDIES IN SHAKESPEARE: THE COMEDIES	3 (3-0) S

ENG 660	19TH-CENTURY ENGLISH LITERATURE: THE VICTORIAN PERIOD	3 (3-0) S
ENG 665	19TH-CENTURY AMERICAN LITERATURE: THE PERIOD OF REALISM AND NATURALISM	3 (3-0) S
ENG 670A	20TH-CENTURY BRITISH LITERATURE (PROSE) (Offered in alternate years.)	3 (3-0) S
ENG 670B	20TH-CENTURY BRITISH LITERATURE (POETRY) (Offered in alternate years.)	3 (3-0) S
ENG 675A	20TH-CENTURY AMERICAN LITERATURE (PROSE) (Offered in alternate years.)	3 (3-0) F
ENG 675B	20TH-CENTURY AMERICAN LITERATURE (POETRY) (Offered in alternate years.)	3 (3-0) F
ENG 680A	20TH-CENTURY DRAMA (BRITISH) (Offered in alternate years.)	3 (3-0) S
ENG 680B	20TH-CENTURY DRAMA (AMERICAN) (Offered in alternate years.)	3 (3-0) S
ENG 692	SPECIAL TOPICS IN AMERICAN LITERATURE	3 (3-0) FS
ENG 693	SPECIAL TOPICS IN ENGLISH LITERATURE	3 (3-0) FS
ENG 699	RESEARCH IN LITERATURE (THESIS)	Credits Arranged F S

ENTOMOLOGY

FOR UNDERGRADUATES

ENT 301	INTRODUCTION TO FOREST INSECTS	3 (2-2) F
Prerequisite: FOR 264		

An introductory course covering the fundamentals of classification, development, habit and control of forest insects.
Mr. Farrier

ENT 312	INTRODUCTION TO ECONOMIC INSECTS	3 (2-2) FS
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A basic course, covering the fundamentals of insect classification, development, food habits and controls.
Mr. Brett

FOR ADVANCED UNDERGRADUATES

ENT 401 (ZO 401)	BIBLIOGRAPHIC RESEARCH IN BIOLOGY	1 (1-0) F
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A general course intended to acquaint students with literature problems of the scientist, mechanics of the library book classifications, bibliographies, abstract journals, taxonomic indexes and preparation of scientific papers in agriculture, forestry, biology and their subdivisions. (Offered fall, 1972 and alternate years.)
Mr. Farrier

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ENT 502 INSECT DIVERSITY

4 (2-4) F

Prerequisites: Twelve hours of biology

An introduction to the external morphology of insects and a survey of the biology and identification of immature and adult insects. Evolutionary relationships of insects and other arthropods, speciation, insect zoogeography, nomenclature, and classical and recent approaches to systematics are also considered.

Messrs. Axtell, Neunzig, Rabb, Young

ENT 503 FUNCTIONAL SYSTEMS OF INSECTS

4 (2-6) S

Prerequisites: Twelve hours in biology, nine hours in chemistry, three hours of biochemistry, ENT 301 or equivalent

Structure and morphological variations of organ systems in insects including considerations of their histology and function. Sensory and general physiology will then lead into basic elements of insect orientation and behavior.

Messrs. Campbell, Hodgson, Yamamoto

ENT 504 INSECT MORPHOLOGY

3 (1-4) F

Prerequisite: ENT 502

Concerned with external morphology, primary and comparative phases, with emphasis on knowledge and techniques which can be applied to specific problems. (Offered fall, 1971 and alternate years.)

Mr. Young

ENT 511 SYSTEMATIC ENTOMOLOGY

3 (1-4) F

Prerequisite: ENT 301 or ENT 312 or equivalent

A somewhat detailed survey of the orders and families of insects, designed to acquaint the student with those groups and develop in the student some ability in the use of the taxonomic literature. (Offered fall, 1972 and alternate years.)

Mr. Young

ENT 520 INSECT PATHOLOGY

3 (2-3) S

Prerequisites: Introductory entomology and introductory microbiology

A treatment of the noninfectious and infectious diseases of insects, the etiological agents and infectious processes involved, immunological responses and applications. (Offered spring, 1971 and alternate years.)

Mr. Brooks

ENT 531 INSECT ECOLOGY

3 (2-2) F

Prerequisite: ENT 502

The environmental relations of insects, including insect development, habits, distribution and abundance. (Offered fall, 1971 and alternate years.)

Messrs. Bradley, Rabb

ENT 541 IMMATURE INSECTS

2 (1-3) F

Prerequisite: ENT 502 or equivalent

An advance study of the immature stages of selected orders of insects with emphasis on generic and specific taxa. Primary consideration is given to the larval stage, but a brief treatment of eggs and pupae is also included. (Offered fall, 1972 and alternate years.)

Mr. Neunzig

ENT 542 ACAROLOGY

3 (2-3) S

Prerequisite: ENT 301 or ENT 312 or ZO 201

A systematic survey of the mites and ticks with emphasis on identification, biology and control of the more common and economic forms attacking material, plants and animals including man. (Offered spring, 1971 and alternate years.)

Mr. Farrier

ENT 550 FUNDAMENTALS OF INSECT CONTROL 3 (3-0) F
 Prerequisites: ENT 312 or ENT 301 and senior standing
 The course is divided into two phases. The first deals with the basic causes of insect problems, an evaluation of the biological and economic aspects of insect attack and the fundamental methods employed in insect control. The second part deals with the critical chemical, physical and biological properties of compounds used for insect control. The material presented in the course is directed toward obtaining fundamental knowledge of the scientific principles underlying modern methods of protection of food, clothing, shelter and health from arthropods.
 Mr. Guthrie

ENT 551 FUNDAMENTALS OF INSECT CONTROL LABORATORY 2 (0-4) F
 Prerequisite or corequisite: ENT 550

A laboratory course designed to supplement ENT 550. The student will be introduced to specific insect problems including recognition and evaluation of damage. Practical procedures for design of field plots and statistical procedures for sampling pest management practices will be included. Selected laboratory experiments and demonstrations will include determination of the LD-50, cholinesterase inhibition, residue analysis, mass rearing and evaluation of application equipment.
 Mr. Rock

ENT 562 AGRICULTURAL ENTOMOLOGY 3 (2-3) S
 Prerequisite: ENT 301 or ENT 312

A study of the taxonomy, biology and ecology of beneficial and injurious insects and arachnids of agricultural crops. Advantages and limitations of the advanced concepts for controlling insect and mite populations on different crops will be emphasized. (Offered spring, 1972 and alternate years.)
 Messrs. Bradley, Rock

ENT 575 (PHY 575, ZO 575) PHYSIOLOGY OF INVERTEBRATES 3 (3-0) S
 (See zoology, page 461.)

ENT 582 (ZO 582) MEDICAL AND VETERINARY ENTOMOLOGY 3 (2-3) S
 Prerequisites: ENT 301 or ENT 312 and ZO 315 or equivalent

A study of the morphology, taxonomy, biology and control of the arthropod parasites and disease vectors of man and animals. The ecology and behavior of vectors in relation to disease transmission and control will be emphasized. (Offered spring, 1972 and alternate years.)
 Mr. Axtell

ENT 590 SPECIAL PROBLEMS Credits Arranged FS
 Prerequisites: Graduate standing, consent of instructor

Original research on special problems in entomology not related to a thesis problem, but designed to provide experience and training in research.
 Graduate Staff

FOR GRADUATES ONLY

ENT 602 PRINCIPLES OF TAXONOMY 3 (1-4) S

ENT 611 BIOCHEMISTRY OF INSECTS 3 (3-0) F

ENT 622 INSECT TOXICOLOGY 3 (2-3) S

ENT 690 SEMINAR 1 (1-0) F S

ENT 699 RESEARCH Credits Arranged F S

NUTRITION

NTR 301 (ANS 301, FS 301) NUTRITION AND MAN (See animal science, page 241.)	3 (3-0) FS
NTR 415 (ANS 415, PO 415) COMPARATIVE NUTRITION (See animal science, page 243.)	3 (3-0) F
NTR 601 AMINO ACIDS, VITAMINS AND MINERALS IN NUTRITION	4 (4-0) S
NTR 608 ENERGY METABOLISM	3 (3-0)

PHYSIOLOGY

PHY 502 (ANS 502) REPRODUCTIVE PHYSIOLOGY OF VERTEBRATES (See animal science, page 243.)	3 (3-0)
PHY 575 (ENT 575, ZO 575) PHYSIOLOGY OF INVERTEBRATES (See zoology, page 461.)	3 (3-0)
PHY 590 SPECIAL PROBLEMS IN PHYSIOLOGY Prerequisite: Graduate standing, consent of instructor	Credits Arranged

FOR GRADUATES ONLY

PHY 604 (ANS 604) EXPERIMENTAL ANIMAL PHYSIOLOGY	4 2-4) F
PHY 690 PHYSIOLOGY SEMINAR	1 (1-0) S
PHY 695 SELECTED TOPICS IN PHYSIOLOGY	1-4
PHY 699 PHYSIOLOGICAL RESEARCH	Credits Arranged

TOXICOLOGY

TOX 510 INTRODUCTION TO BIOCHEMICAL TOXICOLOGY Prerequisite: Senior standing in biochemistry	2 (2-0)
TOX 515 ENVIRONMENTAL TOXICOLOGY Prerequisite: Two years of biology	2 (2-0)
TOX 590 SPECIAL PROBLEMS IN TOXICOLOGY Prerequisite: Graduate standing	1-3

FOR GRADUATES ONLY

TOX 690 TOXICOLOGY SEMINAR	1 (1-0)
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FOOD SCIENCE

FOR UNDERGRADUATES

FS 201 FOOD SCIENCE AND TECHNOLOGY

3 (2-3) F

An introduction to the sciences involved in the processing of foods. The role of foods and the food industry in the development of man. The relationships between production, processing and consumption. Principles and methods of food preservation. Laboratories and field trips will acquaint students with typical processing operations and representative food industries.

Mr. Warren

FS 301 (ANS 301, NTR 301) NUTRITION AND MAN

3 (3-0) F S

(See animal science, page 241.)

FS 331 (BAE 331) FOOD ENGINEERING

3 (2-3) F

Prerequisite: PY 211 or PY 221

Engineering concepts and their application to the food industry will be presented. Principles of thermodynamics, fluid flow, heat transfer, refrigeration and electricity will be emphasized.

Mr. V. Jones

FS 400 FOODS AND NUTRITION

3 (3-0) S

Prerequisite: CH 220

A study of the health of an individual as related to food and the ability of his body to use food. Evaluation of normal diets and factors that promote optimal nutrition throughout life, and the application of biochemistry to utilization of foods.

Mr. Aurand

FS 402 FOOD CHEMISTRY

3 (3-0) F

Prerequisite: CH 220 or CH 221

An introduction to the biochemistry of foods with emphasis on the basic composition, structure, properties and nutritive value of food. The chemistry of changes occurring during processing and utilization of foods will also be studied.

Mr. Hansen

FS 404 (PO 404) POULTRY PRODUCTS

3 (2-3) F

Prerequisites: CH 101, BS 100

Biological principles of processing, preservation and marketing of poultry meat and eggs.

Mr. Ball

FS 405 (MB 405) FOOD MICROBIOLOGY

3 (2-3) F

Prerequisite: MB 301 or MB 401

The microorganisms of importance in foods, and their cultural and metabolic activities in foods. The physical and chemical destruction of microorganisms in foods and kinetics involved. The conversion of raw foods by microorganisms into altered foods and the nutrition, growth and preservation of the cultures involved. Foods as vectors of human pathogens. The evolution of microbiological standards for foods.

Mr. Speck

FS 409 (ANS 409) MEAT AND MEAT PRODUCTS

3 (2-3) S

Prerequisite: CH 220

A study of the basic principles involved in processing of beef, pork and lamb from the live animal to the various representative cured, fresh, canned and comminuted meat items currently produced.

Mr. Blumer

FS 432 FOOD ENGINEERING II**3 (2-3) S****Prerequisite:** FS 331

The theory and principles of evaporation, drying and distillation will be discussed with emphasis on applications in the processing of foods. Instrumentation and control systems used in the food industry will also be presented.

Mr. V. Jones**FS 490 FOOD SCIENCE SEMINAR****1 (1-0) S****Prerequisite:** Senior standing

A review and discussion of scientific articles, new developments and topics of current interest in the food industry.

Messrs. Roberts, Warren**FOR GRADUATES AND ADVANCED UNDERGRADUATES****FS 503 FOOD ANALYSIS****3 (1-6) S****Prerequisites:** CH 315, BCH 351, FS 402

A study of the principles, methods and techniques necessary for quantitative physical and chemical analyses of food and food products. Results of analyses will be studied and evaluated in terms of quality standards and governing regulations.

Mr. Johnson**FS 504 ADVANCED FOOD CHEMISTRY****3 (3-0) S****Prerequisite:** BCH 551

Studies on the molecular properties of food components, their interactions and reactions and the physico-chemical alterations occurring in the maturation, harvest, process and storage stages.

Mr. Aurand**FS 506 (MB 506) ADVANCED FOOD MICROBIOLOGY****3 (1-6) S****Prerequisite:** FS 405 or equivalent

The interactions of microorganisms in foods and their roles in food spoilage and bioprocessing. Cellular and molecular relationships in bacterial injury, repair and aging resulting from environmental stresses. Bacterial sporulations, germination and physiological properties of bacterial spores.

Mr. Speck**FS 511 FOOD RESEARCH AND DEVELOPMENT****3 (2-3) S****Prerequisites:** FS 331, FS 402, FS 405

A study of the scientific principles underlying the development of new and improved food products and processes. Special emphasis will be placed on the application of research and development principles to meat, poultry and fisheries industries.

Mr. Webb**FS 516 QUALITY CONTROL OF FOOD PRODUCTS****3 (2-3) S****Prerequisites:** FS 331, FS 402, FS 405

A study of quality control fundamentals in the food industry including specifications and standards, testing procedures, sampling, statistical and quality control, and organization. Food products and industry problems will be used in the presentation with special emphasis on dairy products.

Mr. Warren**FS 521 (HS 521) FOOD PRESERVATION****3 (2-3) F****Prerequisites:** MB 401 or FS 405, FS 402 or BO 421

An examination of principles and methods employed in the preservation of foods. Major emphasis will be focused on thermal, freezing, drying and fermentation processes and their relationship to physical, chemical and organoleptic changes in product. In addition, the relationship of these preservation techniques to the development of an overall processing operation will be considered.

Mr. Carroll

FS 562 (HS 562) POST-HARVEST PHYSIOLOGY**3 (3-0) S****Prerequisite:** BO 421

A study of chemical and physiological changes that occur during handling, transportation and storage which affect the quality of horticultural crops. Consideration will be given to pre- and post-harvest conditions which influence these changes.

Mr. Ballinger**FS 591 SPECIAL PROBLEMS IN FOOD SCIENCE****Maximum 6 F S****Prerequisite:** Graduate or senior standing

Analysis of scientific, engineering and economic problems of current interest in foods. Credit for this course will involve the scientific appraisal and solution of a selected problem. The problems are designed to provide training and experiences in research.

Graduate Faculty**FOR GRADUATES ONLY****FS 601 THEORY OF PHYSICAL MEASUREMENTS OF BIOPOLYMERS****3 (2-3) S****FS 690 SEMINAR IN FOOD SCIENCE****1 (1-0) F S****FS 691 SPECIAL RESEARCH PROBLEMS IN FOOD SCIENCE****Credits Arranged****FS 699 RESEARCH IN FOOD SCIENCE****Credits Arranged****FORESTRY****FOR UNDERGRADUATES****FOR 101 (WPS 101) INTRODUCTION TO FOREST RESOURCES****1 (1-0) F**

The profession of forestry, its scope and opportunities; conservation of natural resources.

Staff**FOR 204 SILVICULTURE****2 (0-6) Sum.****Sophomore Summer Camp****Prerequisite:** Junior standing in forestry

Field exercises to enable the student to describe and measure factors of the forest environment, the ecology of forest communities, tree structure and growth, and tree and stand response to treatments which are normal parts of forest management operations.

Mr. Duffield**FOR 210 DENDROLOGY—GYMNOSPERMS****2 (1-2) S****Prerequisite:** BO 200

Identification, relationships and distribution of gymnosperm trees, with emphasis on the characteristics of genera and higher taxonomic groups.

Mr. Duffield**FOR 211 DENDROLOGY—ANGIOSPERMS****2 (1-2) F****Prerequisite:** BO 200

Identification, relationships and distribution of angiosperm trees, with emphasis on the characteristics of genera and higher taxonomic groups.

Mr. Duffield

- FOR 219 (WPS 219) FOREST ECONOMY AND ITS OPERATION 3 (2-2) F
Prerequisite: EC 206 or EC 212
Multiple use concept of forestry; economic principles underlying production; investment problems; factors which influence demand for forest products.
Mr. Steensen
- FOR 263 DENDROLOGY 1 (0-3) Sum.
Sophomore Summer Camp
Prerequisite: Junior standing in forestry
Identification of trees, shrubs and woody vines of the Piedmont and mountain regions of North Carolina, principally by bark, foliage, flowers and developing fruits.
Mr. Perry
- FOR 264 FOREST PROTECTION 2 (0-6) Sum.
Sophomore Summer Camp
Prerequisite: Junior standing in forestry
Identification and control of forest insects and diseases. Behavior of fire and the meteorological factors affecting fire behavior. Suppression of a large simulated fire, including use of modern ground equipment, aircraft and communications systems.
Staff
- FOR 272 FOREST MENSURATION 3 (2-2) S
Scientific basis for the measurements and estimates required in the management of forest resources and the goods and services derived from forest land. Included are theory of measurements, the required procedures, instrumentation and statistical prerequisites, with emphasis on sampling problems. Mr. Steensen
- FOR 273 (WPS 273) QUANTITATIVE METHODS IN FOREST RESOURCES 3 (2-2) FS
Prerequisite: Sophomore standing
Problem solving techniques in the areas of forestry, wood technology, pulp and paper technology and recreation resources. Historical development of past techniques, assessment of present technology, and an evaluation of problem solving tools, including an introduction to the use of computers.
Mr. Gemmer
- FOR 274 MAPPING AND MENSURATION 4 (0-12) Sum.
Sophomore Summer Camp
Prerequisite: FOR 272
Use of surveying instruments and graphic methods in preparation of topographic and planimetric maps of forested areas. Measurement of height, diameter, bole form and age of trees. Study of stand density, growing stock levels and financial maturity. Stem analysis, sampling and site index determinations.
Mr. Bryant
- FOR 284 UTILIZATION 1 Sum.
Sophomore Summer Camp
Prerequisite: Junior standing in forestry
Inspection of wood industries; expositions on manufacturing processes. Staff
- FOR 318 (PP 318) FOREST PATHOLOGY 3 (2-3) Sum.
(See plant pathology, page 408.)
- FOR 353 AIR PHOTO INTERPRETATION 3 (2-3) S
Prerequisite: Junior standing
Theory, principles and techniques of utilizing air photos as data sources for planning and management of renewable resources. Particular attention will be

directed to stereoscopic identification and examination of the bioecological factors of terrain, plants, growing conditions, water, wildlife and the changes brought about by the activities of man. Mr. Lammi

FOR 405 FOREST LAND MANAGEMENT
Prerequisites: FOR 272, FOR 452

5 (2-6-2) F

Management of forest lands for multiple benefits. The principles and techniques applied in regulating regeneration, species composition, growth and quality of woody vegetation; the use of planting, seeding, cutting, herbicides and fire in the management of vegetation. The application of financial principles in making decisions regarding investments in forest management. Messrs. Bryant, Duffield

FOR 406 FOREST LAND INVENTORY AND PLANNING
Prerequisite: FOR 405

6 (2-12) S

Applications of land management systems, including silviculture, protection, utilization and related problems in evaluation of assigned forest areas. Students complete a resource inventory and submit individual plans for management of the assigned tract. Mr. Bryant

FOR 423 (WPS 423) LOGGING AND MILLING
(See wood and paper science, page 455.)

3 (2-3) F

FOR 452 SILVICS

4 (3-2) S

Prerequisites: BO 200, CH 103, PY 221 or PY 212, mathematics through calculus

Physiological ecology of the plants composing forest communities, including consideration of genotypic and phenotypic variation. Plant responses to environmental factors, including plant interactions are emphasized as a basis for developing techniques of manipulating forest communities. Consideration is given to effects of ecosystem manipulation on aesthetic values and on wildlife habitats. Mr. Perry

FOR 462 ARTIFICIAL FORESTATION

2 (1-3) S

Biology of seed production for forest trees; forest tree seed collection, extraction, storage and testing; biology of tree seedling growth; soil aspects of nursery management; forest nursery operation; soil aspects of site preparation, planting and direct seeding; reforestation operations. (Offered spring, 1972 and alternate years.) Messrs. Davey, Duffield

FOR 472 RENEWABLE RESOURCE MANAGEMENT

3 (3-0) F

Prerequisites: A basic course in biology and economics; junior or senior standing

The concepts and problems of coordinated use and management of the renewable resources namely soil, water, vegetation and fauna. Man as a biological factor interacting with other components of terrestrial ecological systems, particularly forests and related communities. Consideration is given to the interrelationships of forests, water, range-land, wildlife and outdoor recreation and their aesthetic and economic values. Inventory and management techniques and economic policies relating to renewable resources are examined and discussed. (Not open to forestry majors.) Staff

FOR 491 (WPS 491) SENIOR PROBLEMS IN FOREST RESOURCES

Credits Arranged

Prerequisite: Consent of department

Problems selected with faculty approval in the areas of management or technology. Staff

FOR 492 (WPS 492) SENIOR PROBLEMS IN FOREST RESOURCES

Credits Arranged

Prerequisite: Consent of department

Problems selected with faculty approval in the areas of management or technology. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

FOR 501 FOREST INFLUENCES AND WATERSHED MANAGEMENT 3 (3-0) F
Prerequisite: Advanced undergraduate or graduate standing

Study of the effects of woody vegetation on climate, water and soil, with applications of the knowledge of forest influences to management of forest land resources, including conservation and yield of water, stabilization of streamflow and soils, reduction of sedimentation and general improvement of the environment.
Mr. Maki

FOR 512 FOREST ECONOMICS 3 (3-0) S
Prerequisite: Basic course in economics or consent of instructor

Economics and social value of forests; supply of, and demands for forest products; land use; forestry as a private and a public enterprise; economics of the forest industries.
Staff

FOR 553 FOREST PHOTOGRAMMETRY 3 (2-3) S
Prerequisite: Basic measurements course or consent of instructor

The stereoscopic use of aerial photographs for land use and vegetation interpretation will be emphasized. Some developments in remote sensing of environment will be reviewed, including infrared light, thermal infrared, microwave and radar imagery. Laboratory exercises include identification of plant cover and culture, measurement of elevations and heights of objects, determination of tree cover densities and volumes, road location and rudimentary mapping.
Mr. Lammi

FOR 571 ADVANCED FOREST MENSURATION 3 (2-2) S
Prerequisites: FOR 272, ST 311

Study of the development of mathematical models to describe forest resources phenomena; criteria for evaluating the "goodness" of such models; and methods of data collection for use in the evaluation.
Mr. Hafley

FOR 572 CONSERVATION POLICY ISSUES 3 (3-0) S
Prerequisite: Seniors and graduates, or consent of instructor

Analysis of the attitudes of selected private groups and public agencies toward multiple resource development. Special attention is directed to the trends in development of forest resource policies, timber management objectives, private industry activity in forestry development, recreation and multiple use, education, research, watersheds, governmental activity, interaction in international forestry affairs and the role of professional foresters and related specialists in multiple use resource management.
Mr. Lammi

FOR 591 (WPS 591) FORESTRY PROBLEMS Credits Arranged
Prerequisite: Senior or graduate standing

Assigned or selected problems in the field of silviculture, harvesting operations, lumber manufacturing, wood science, pulp and paper science, wood chemistry or forest management.
Staff

FOR 599 (WPS 599) METHODS OF RESEARCH IN FORESTRY Credits Arranged
Prerequisite: Senior or graduate standing

Research procedures, problem analysis, working plan preparation, interpretation and presentation of results; evaluation of selected studies by forest research organizations; techniques and constraints in the use of sample plots.
Staff

FOR GRADUATES ONLY

FOR 611 (GN 611)	FOREST GENETICS	3 (3-0) S
FOR 612 (GN 612)	ADVANCED TOPICS IN QUANTITATIVE GENETICS	3 (3-0) F
FOR 613	SPECIAL TOPICS IN SILVICULTURE	3 (2-1) F
FOR 614	ADVANCED TOPICS IN FOREST LAND MANAGEMENT	3 (3-0) F
FOR 691 (WPS 691)	GRADUATE SEMINAR	1 (1-0) FS
FOR 692	ADVANCED FOREST MANAGEMENT PROBLEMS	Credits Arranged
FOR 699 (WPS 699)	PROBLEMS AND RESEARCH	Credits Arranged

GENETICS

FOR UNDERGRADUATES

GN 301	GENETICS IN HUMAN AFFAIRS	3 (3-0) FS
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Fundamental principles of genetics will be presented at a level not requiring courses in biological sciences but sufficient for an understanding of the relation of genetics to society and technology. A survey will be given of current knowledge of inheritance of human traits.

Messrs. Bostian, McKenzie

FOR ADVANCED UNDERGRADUATES

GN 411	THE PRINCIPLES OF GENETICS	3 (3-0) FS
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Prerequisites: BS 100

An introductory course. The physical and chemical basis of inheritance; genes as functional and structural units of heredity and development; qualitative and quantitative aspects of genetic variation.

Mr. Johnson

GN 412	ELEMENTARY GENETICS LABORATORY	1 (0-2) FS
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Prerequisite or corequisite: GN 411

Experiments and demonstrations to provide an opportunity to gain practical experience in crossing and classifying a variety of genetic materials including two generations of *Drosophila*.

Mr. Johnson, Graduate Assistants

FOR GRADUATES AND ADVANCED UNDERGRADUATES

GN 504	HUMAN GENETICS	3 (3-0) S
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Prerequisite: GN 301 or GN 411 or equivalent

The basic principles needed for an understanding of the genetics of man will be presented. Current knowledge and important areas of research in human genetics will be surveyed. This course will not be accepted in the core requirements for an advanced degree in genetics but is intended to serve the needs of advanced undergraduates and graduates other than majors in genetics.

Messrs. Bostian, Schaffer

- GN 505 GENETICS I** 4 (3-2) F
 Prerequisite: GN 411 or equivalent
 Part I of a course sequence designed to serve as a foundation for graduate programs in genetics. As such, balanced and comprehensive survey of each of the major fields of genetics must be presented in integrated form. Concepts based upon family analysis and a study of individual organisms will be presented here. Coverage will include general plant and animal genetics, biochemical and microbial genetics, and physiological and developmental genetics. Messrs. Grosch, Kloos
- GN 506 GENETICS II** 4 (3-2) S
 Prerequisite: GN 505 or consent of instructor
 This course represents the second portion of a two-semester sequence in General Genetics, which is presented at the intermediate level and directed primarily to beginning graduate students. Emphasis is placed on the basic principles and modern concepts of cytogenetics, population genetics and quantitative genetics. These subjects are intergrated with those of the first semester course as much as possible, with the primary synthesis being directed toward the dynamic aspects of evolutionary theory, including both intra- and interpopulational phenomena. Mr. Mettler, Staff
- GN 508 (ANS 508) GENETICS OF ANIMAL IMPROVEMENT** 3 (3-0) FS
 (See animal science, page 243.)
- GN 513 CYTOGENETICS** 4 (3-2) F
 Prerequisite: GN 506 or consent of instructor
 Classical and contemporary problems of chromosome structure, behavior and transmission. Euchromatin and heterochromatin. Recombination. Structural and numerical aberrations of chromosomes and the effects upon breeding systems of plants and animals. Interspecific hybridization. Polyploidy. Messrs. Galletta, Gerstel
- GN 520 (PO 520) POULTRY BREEDING** 3 (2-2) F
 (See poultry science, page 417.)
- GN 532 (ZO 532) BIOLOGICAL EFFECTS OF RADIATIONS** 3 (3-0) S
 Prerequisite: BS 100 or GN 301 or consent of instructor
 Qualitative and quantitative effects of radiations (other than the visible spectrum) on biological systems, to include both morphological and physiological aspects in a consideration of genetics, cytology, histology and morphogenesis. Mr. Grosch
- GN 540 (ZO 540) EVOLUTION** 3 (3-0) F
 Prerequisites: GN 411; undergraduates need consent of instructor
 The facts and theories of evolution in plants and animals. The causes and consequences of organic diversity. Mr. Smith
- GN 541 (CS 541, HS 541) PLANT BREEDING METHODS** 3 (3-0) F
 (See crop science, page 279.)
- GN 542 (CS 542, HS 542) PLANT BREEDING FIELD PROCEDURES** 2 (0-4) Sum.
 (See crop science, page 279.)
- GN 545 (CS 545) ORIGIN AND EVOLUTION OF CULTIVATED PLANTS** 2 (2-0) S
 (See crop science, page 279.)
- GN 550 (ZO 550) EXPERIMENTAL EVOLUTION** 3 (3-0) F
 Prerequisite: GN 506 or consent of instructor
 Experimental evolution deals with processes examined at the inter- and intra-population levels. A review of the results from experimental population studies

and analyses of natural populations concerning variation patterns and adaptation, natural selection, polymorphism, hybridization, introgression, population breeding structure, isolating mechanisms, etc., is made and interpreted in relation to Darwinian and the modern synthesis concepts of the origin of species.

Mr. Mettler

GN 561 (BCH 561, MB 561) BIOCHEMICAL AND MICROBIAL GENETICS 3 (3-0) F
Prerequisites: BCH 351 or BCH 551, GN 411 or GN 505, MB 401 or equivalent

A study of the development of the fields of biochemical genetics and microbial genetics emphasizing both techniques and concepts currently used in research in these areas. Includes lectures and discussions of current research publications.

Mr. Armstrong

FOR GRADUATES ONLY

GN 603 (ANS 603)	POPULATION GENETICS IN ANIMAL IMPROVEMENT	3 (3-0) F
GN 611 (FOR 611)	FOREST GENETICS	3 (3-0) S
GN 612 (FOR 612)	ADVANCED TOPICS IN QUANTITATIVE GENETICS	3 (3-0) F
GN 613 (CS 613, HS 613)	PLANT BREEDING THEORY	3 (3-0) S
GN 626 (ST 626)	STATISTICAL CONCEPTS IN GENETICS	3 (3-0) S
GN 631	MATHEMATICAL GENETICS	3 (3-0) F
GN 633	PHYSIOLOGICAL GENETICS	3 (3-0) S
GN 641	COLLOQUIUM IN GENETICS	2 (2-0) FS
GN 691	SEMINAR	1 (1-0) FS
GN 695	SPECIAL PROBLEMS IN GENETICS	1-3 FS
GN 699	RESEARCH	Credits Arranged

GEOLOGY

FOR UNDERGRADUATES

GY 101 EARTH SCIENCE 3 (3-0) S
Not to be taken after GY 120

Introductory course in general geology; changes in the earth, and underlying physical and life processes.

GY 120 PHYSICAL GEOLOGY 3 (2-3) F S

Dynamic processes acting on and within the earth; materials and makeup of the earth's crust; emphasis on engineering and agricultural applications in the Southeast. Lectures, laboratories and field trips.

GY 208 PHYSICAL GEOGRAPHY AND METEOROLOGY 3 (2-3) S

Study of the physical conditions on the earth's surface that influence human

activities; factors of man's environment; including planetary conditions, geographic location, climate and weather, soils and land forms.

GY 220 PHYSICAL-HISTORICAL GEOLOGY

4 (3-3) Sum.

Prerequisite: CH 101

A broad introductory survey of earth materials, processes and history. Common minerals and rocks. Effect of solar, gravitational, chemical and internal-thermal energy in transforming crustal constitution, structure, position and surface form. Measurement and subdivision of geologic time scale. The time scale, geosynclinal and tectonic cycles. Typical major geologic events in North America. Evolution of the main fossil groups.

GY 222 HISTORICAL GEOLOGY

3 (2-3) S

Prerequisite: GY 120

Chronologic account of the geologic events during the development of the earth's crust, mainly in North America. Evolution and environmental significance of the principal fossil animal and plant groups.

GY 323 PALEONTOLOGY

3 (2-3) F

Prerequisite: GY 220 or GY 222

Study of fossil life forms, with major emphasis on classification and structure of the invertebrate animals and their application to problems of correlation of strata. Lecture, laboratories and field trips.

GY 330 CRYSTALLOGRAPHY AND MINERALOGY

3 (2-3) S

Prerequisite: GY 120

The elements of morphological crystallography. Space lattices, crystal symmetry, systems and classes. Stereographic projection of common forms. Identification of minerals by crystallographic features, cleavage, fracture, luster, color, streak, hardness, specific gravity, etc. Chemical composition, varieties, occurrence, associations, important localities and uses. Crystal structures of selected minerals.

GY 331 OPTICAL MINERALOGY AND X-RAY DIFFRACTION

4 (2-4) F

Prerequisite: GY 330

Techniques and underlying optical theory for identifying minerals with the polarizing microscope. Determination of index of refraction and birefringence; isotropic, uniaxial or biaxial character; optic sign and orientation. Adjunct apparatus for statistical and petrographic studies. Generation of x-rays, techniques and underlying theory for identifying by x-ray diffraction.

GY 351 TECTONIC STRUCTURES

3 (2-3) F

Prerequisite: GY 120 or GY 220

Applications of the principles of mechanics to an understanding of rock deformation. Analysis of fracture, solid flow and fluid flow structure imposed on igneous, sedimentary and metamorphic rock masses by internal crustal forces and gravitational movements. Stress-strain relations of rocks and minerals under surface conditions, and the modification of behavior which results from pore solutions and increase of confining pressure, temperature and time.

GY 415 MINERAL EXPLORATION AND EVALUATION

3 (2-3) S

Prerequisites: GY 440, GY 452

Application of the principles of geology, geophysics and geochemistry to the discovery and evaluation of mineral deposits. Design of mineral exploration and development programs based on knowledge of the unique thermodynamic, geochemical and tectonic features that control mineral formation and concentrations in well-known mining districts, especially those yielding ferrous, base and precious metals. Review of economic and technological factors governing the value of mineral deposits. Field trips.

GY 440 IGNEOUS AND METAMORPHIC PETROLOGY**4 (3-3) S****Prerequisites:** GY 120 or GY 220, GY 331

Minerals, rocks and mineral deposits that are formed at high temperatures and pressures by crystallization or solidification of molten magma or by solid-state recrystallization of older rocks. Application of principles of thermodynamics and of phase-rule chemistry, and of the results of modern high pressure-temperature laboratory research on the stability fields of crystalline phases, to an understanding of igneous and metamorphic rocks. Identification, classification, occurrence, origin and economic value of the principal igneous and metamorphic rocks.

GY 452 EXOGENIC MATERIALS AND PROCESSES**4 (3-3) S****Prerequisites:** GY 120 or GY 220, GY 331

Identification, classification, geologic occurrences, origin and economic value of minerals, rocks and mineral deposits formed by physical, chemical and biological processes at low temperatures and pressures at and near the earth's surface. Hydrodynamics of sediment transport and deposition, settling velocities, and size sorting, chemical and biochemical precipitation from aqueous solutions. Principles of divisions of stratified terranes into natural units, correlation of strata, identification of depositional environments, and facies analysis.

GY 461 ENGINEERING GEOLOGY**3 (3-0) F****Prerequisite:** GY 120 or GY 220

The application of geologic principles to engineering practice; analysis of geologic factors and processes affecting specific engineering projects. (Offered fall, 1971 and alternate years.)

GY 462 GEOLOGICAL SURVEYING**3 (1-5) S****Prerequisite:** GY 120

Methods of field observation and use of geologic surveying instruments in surface and underground work; representation of geologic features by maps, sections and diagrams. Lectures, laboratories and field work.

GY 465 GEOLOGICAL FIELD PROCEDURES**6 Sum.****Prerequisite:** GY 351 or special consent

A six week summer field course. Practical field procedures and instruments commonly used to procure geologic data for evaluating mineral deposits, solving engineering problems involving earth materials, and drawing scientific conclusions. Observation of geologic phenomena in their natural setting. Large and intermediate scale geologic mapping of surface features and large scale mapping underground in mine workings.

GY 486 WEATHER AND CLIMATE**2 (2-0) F****Prerequisites:** MA 102 or MA 112, PY 211, 212 or PY 221

A discussion of basic principles of meteorology and climatology. Topics discussed include the atmosphere, radiation, moisture, pressure and wind, atmospheric equilibrium, air masses and fronts. Macro- and microclimate and the climate of North Carolina are also covered.

GY 491, 492 SEMINAR ON SELECTED GEOLOGIC TOPICS**1-3 F S**

Reports and discussion of geological topics of current interest with attention to methodology, bibliography and research techniques.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

GY 522 PETROLEUM GEOLOGY

3 (3-0) S

Prerequisite: GY 452

Properties, origin and modes of occurrence of petroleum and natural gas. Geologic and economic features of the principal oil and gas fields, mainly in the United States. (Offered spring, 1972 and alternate years.)

GY 532 ORE MICROSCOPY

3 (0-6) F

Prerequisite: GY 331

The theory and technique of microscopic investigation of opaque ore minerals, ores and mill products produced by beneficiation of ores. Studies of compositions and textures of materials in polished surfaces are based on observations of optical and physical properties, etch reactions and microchemical tests. (Offered fall, 1971 and alternate years.)

GY 542 MICROSCOPIC PETROGRAPHY

3 (1-4) S

Prerequisites: GY 331, GY 440

Systematic study by microscopic techniques of the constitution and origin of consolidated rocks.

GY 545 ADVANCED PETROLOGY

3 (3-0) F

Prerequisites: GY 331, GY 440

Study of physiochemical principles related to igneous and metamorphic petrogenesis; consideration of general principles and specific problems such as differentiation, origin of magmas and metamorphism. (Offered fall, 1971 and alternate years.)

GY 552 EXPLORATORY GEOPHYSICS

3 (3-0) S

Prerequisites: GY 351, PY 208 or PY 212

Fundamental principles underlying all geophysical methods; procedure and instruments involved in gravitational, magnetic, seismic, electrical and other methods of studying geological structures and conditions. Spontaneous potential, resistivity, radioactivity, temperature and other geophysical logging methods. Study of applications and interpretations of results. (Offered spring, 1971 and alternate years.)

GY 563 APPLIED SEDIMENTOLOGY

3 (2-3) F

Prerequisites: GY 452, ST 361

Extension of GY 452, with emphasis on coarser grained detrital and chemical sedimentary rocks. Sampling of sedimentary population, critical study of assumptions underlying standard measurement techniques; treatment, testing and evaluation of sedimentary data; application to problems in sedimentology.

GY 564 LITHOSTRATIGRAPHY AND BASIN ANALYSIS

3 (2-3) S

Prerequisite: GY 452 or graduate standing

Fabric of large sedimentary basins in terms of the spatial distribution of component major rock facies; current litho-genetic models illustrating internal lithic relationships, variability, and predictability; evolution of litho-genetic units; comparison with recent equivalents; field trips.

GY 565 HYDROGEOLOGY

3 (3-0) S

Prerequisite: GY 452

Occurrence and sources of surface and subsurface water. Relationships of surface water to subsurface water. Rock properties affecting infiltration, movement,

lateral and vertical distribution, and quality of ground water. Determination of permeability, capacity, specific yield and other hydraulic characteristics of aquifers. Principles of well design, legal aspects of water supplies. (Offered spring, 1971 and alternate years.)

GY 567 GEOCHEMISTRY

3 (3-0) F

Prerequisite: CH 331 or CH 433

The quantitative distribution of elements in the earth's crust, the hydrosphere and the atmosphere. Application of the laws of chemical equilibrium and resultant chemical reactions to natural earth systems. Geochemical application of Eh-pH diagrams. Geochemical cycles. Isotope geochemistry. (Offered fall, 1972 and alternate years.)

GY 571, 572 MINING AND MINERAL DRESSING

3 (2-3) F S

Prerequisite: GY 472

Principles of the mineral industry; mining laws, prospecting, sampling, development, drilling, blasting, handling, ventilation and safety; administration; surveying, assaying; preparation, beneficiation and marketing.

GY 581 GEOMORPHOLOGY

3 (3-0) F

Prerequisite: GY 452

A systematic study of land forms and their relations to processes, stages of development and adjustment to underlying structure. Lectures, map interpretations and field trips.

GY 584 (MAS 584) MARINE GEOLOGY

3 (3-0) S

Prerequisite: GY 452 or GY 120 plus appropriate background

Morphology, structure and origin of ocean basins with their diverse features and their relations to the continents. Physical and chemical properties of the oceans, sedimentation in the marine environment and near-shore features. The economic potential of mineral resources derived from oceanic areas. (Offered spring, 1972 and alternate years.)

GY 593 ADVANCED TOPICS IN GEOLOGY

1-6 F S

Prerequisite: Consent of staff

Special study of some advanced phases of geology.

FOR GRADUATES ONLY

GY 611, 612 ADVANCED ECONOMIC GEOLOGY

3 (3-0) F S

GY 695 SEMINAR

1 (1-0) F S

GY 699 GEOLOGICAL RESEARCH

Credits Arranged

GUIDANCE AND PERSONNEL SERVICES

FOR UNDERGRADUATES

ED 420 PRINCIPLES OF GUIDANCE

2 (2-0) F S

This is a course designed to provide basic principles of guidance for teachers, teacher-counselors, administrators and others in the school, as well as workers in

other areas such as the community agency, business, industry, group work and the like.

Among the topics covered are need for guidance; basis of guidance services; programs of studying the individual; counseling for educational, vocational, social and personal problems; group procedures in guidance. Emphasis is on the practical application of guidance principles and procedures. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 520 PERSONNEL AND GUIDANCE SERVICES 3 (3-0) F S

Prerequisite: Six hours of education or psychology

An introduction to the philosophies, theories, principles and practices of personnel and guidance services; the relationship of personnel services with the purposes and objectives of the school and the curriculum. Graduate Staff

ED 521 INTERNSHIP IN GUIDANCE AND PERSONNEL SERVICES Credits Arranged F S

Prerequisite: 18 hours in department

A continuous full-time internship of at least one-half semester. Framework of school and community. Work with students, teachers, administrators, guidance and pupil personnel workers, parents, and resource personnel in the community. Supervision of intern by guidance personnel in a school as well as by course instructors. Graduate Staff

ED 524 OCCUPATIONAL INFORMATION 3 (3-0) S

Prerequisites: Six hours education or psychology, ED 520 or equivalent

This course is intended to give teachers, counselors, placement workers and personnel workers in business and industry an understanding of how to collect, classify, evaluate and use occupational and educational information. This will include a study of the world of work, sources of occupational information, establishing an educational-occupational information library, using educational, occupational and social information and sociological and psychological factors, influencing career planning. Staff

ED 530 GROUP GUIDANCE 3 (3-0) F

Prerequisites: Six hours education or psychology, ED 520 or equivalent

This course is designed to help teachers, counselors, administrators and others who work with groups, or who are responsible for group guidance activities, to understand the theory and principles of effective group work, to develop skill in using specific guidance techniques, and to plan and organize group activities in the secondary school and other institutions. Staff

ED 533 ORGANIZATION AND ADMINISTRATION OF GUIDANCE SERVICES 3 (3-0) S

Prerequisites: Graduate standing, ED 520 or equivalent

This course is designed for school guidance counselors, prospective counselors, personnel and guidance directors, and school administrators. The philosophy and scope of guidance and personnel services; the functions and responsibilities of personnel involved; basic principles and current practices in planning, developing, operating and supervising guidance and personnel services will be studied. Administrative relationships, utilization of school staff, interrelationships of guidance services with instruction and evaluation of guidance services will be considered. Staff

ED 534 GUIDANCE IN THE ELEMENTARY SCHOOL 3 (3-0) S

Prerequisite: Nine hours psychology or consent of instructor

Designed for acquainting elementary school teachers, counselors and administrators with theory, practice and organization of elementary school guidance. Staff

ED 535 STUDENT PERSONNEL WORK IN HIGHER EDUCATION 3 (3-0) F S
 Prerequisite: Nine hours psychology or consent of instructor
 Examines practices in various areas of student personnel work. Studies both structure and function of personnel programs in higher education. Staff

ED 540 INDIVIDUAL AND GROUP APPRAISAL I 3 (3-0) F
 Prerequisites: ED 520, PSY 535, or equivalent

Use of group tests of intelligence, interest and achievement in educational and career planning and in placement. Theories of intelligence and interest will be followed by laboratory in evaluating, administering and interpreting widely used group tests of intelligence, interest and achievement. Emphasis is on the use of group tests in group guidance. Staff

ED 590 INDIVIDUAL PROBLEMS IN GUIDANCE Maximum 6 F S
 Prerequisite: Six hours graduate work in department or equivalent

Intended for individual or group studies of one or more of the major problems in guidance and personnel work. Problems will be selected to meet the interests of individuals. The workshop procedure will be used whereby special projects, reports and research will be developed by individuals and by groups. Staff

FOR GRADUATES ONLY

ED 631 VOCATIONAL DEVELOPMENT THEORY 3 (3-0) F

ED 633 TECHNIQUES OF COUNSELING 3 (3-0) F S

ED 636 OBSERVATION AND SUPERVISED FIELD WORK Maximum 3 F S

ED 640 INDIVIDUAL AND GROUP APPRAISAL II 3 (3-0) F

ED 641 LABORATORY AND PRACTICUM EXPERIENCES IN COUNSELING 2-6 F S

ED 666 SUPERVISION OF COUNSELING 3 (1-8) F S

HISTORY

FOR UNDERGRADUATES

HI 101, 102 HISTORY OF CIVILIZATION 3 (3-0) F S

A history of major civilizations from their ancient beginnings through modern eras. The evolution of significant political, economic, social, cultural and scientific ideas and institutions is stressed and emphasis is given to the interrelationships between European and other civilizations. The first semester covers to 1650, the second semester since that date.

Required for all liberal arts students. HI 101 is a prerequisite for HI 102. *HI 102 is not open to students who have had HI 105.* Students from other schools transferring into liberal arts may substitute HI 105 for HI 102. Staff

HI 105 MODERN WESTERN WORLD 3 (2-1) F S

A history of major movements in the Western World from the Renaissance to the present. Not open to students required to take HI 101, HI 102. Staff

HI 111 THE UNITED STATES THROUGH RECONSTRUCTION 3 (3-0) F S

A study of major historical developments in the growth of the American nation through the political phases of the Reconstruction period following the Civil War. Not open to students who have had HI 241 or HI 242. Staff

HI 112 THE UNITED STATES SINCE RECONSTRUCTION 3 (3-0) F S

A study of major historical developments in the growth of the American nation beginning with the economic and social phases of the Reconstruction period following the Civil War. Not open to students who have had HI 243 or HI 244. Staff

NOTE: The prerequisite for all 200-level courses is three hours of history or advanced placement.

HI 207 THE ANCIENT WORLD TO 180 A. D. 3 (3-0) F S

A study of the ancient cultures of the Middle East and Graeco-Roman civilization. Staff

HI 208 THE MIDDLE AGES 3 (3-0) F S

A study of medieval civilization as it emerged from the declining Roman empire through its apogee in the 13th century. Staff

HI 209 RENAISSANCE TO WATERLOO 1300-1815 3 (3-0) F S

A survey of all aspects of the period of transition from the medieval to the modern world. Staff

HI 210 EUROPE SINCE 1815 3 (3-0) F S

A study of the major political, economic and cultural developments in Europe since 1815. Staff

HI 215 LATIN AMERICA TO 1826 3 (3-0) F

A study of the origins and development of social, political, economic and religious institutions from preconquest times to the achievement of independence. The ancient American cultures; Spain and Portugal before 1492; the conquest and settlement; Spanish rule in theory and practice; economic life; the Church; land and labor; the African contribution; the Portuguese in Brazil; the independence movements. Mr. Bailey

HI 216 LATIN AMERICA SINCE 1826 3 (3-0) S

A survey of social, political, economic and intellectual life in the 19th and 20th centuries. Major attention is given to Mexico, Argentina, Brazil, Peru and Cuba. The social structure of the new nations; 19th century liberalism; the force of tradition; relations with Europe and the United States; the Monroe Doctrine and U. S. intervention; economic change; caudillo rule; 20th century upheavals; the Mexican Revolution; Peron's Argentina; Castro and Latin America. Mr. Bailey

HI 233 THE WORLD IN THE 20TH CENTURY 3 (3-0) F S

A study of national and international problems in the Western and non-Western world. Staff

HI 242 UNITED STATES HISTORY, 1789-1865 3 (3-0) S

Inauguration of the new nation; territorial expansion and the westward movement; growth of democracy and social reform; 19th century nationalism; sectional division and civil war. Not open to students who have had HI 111. Staff

- HI 244 UNITED STATES HISTORY, 1898 TO PRESENT 3 (3-0) S
The emergence of the United States as a world power. Problems and achievements in its 20th century development. Not open to students who have had HI 112.
Staff
- HI 263 TRADITIONAL EAST ASIA: PREHISTORY TO 1800 3 (3-0) F
An introduction to the civilizations of China, Japan and Korea prior to the penetration of Western institutions and ideas.
Mr. Metzgar
- HI 264 MODERN EAST ASIA: 1800 TO PRESENT 3 (3-0) S
An introduction to the western impact and the responses in China, Japan and the smaller nations of East and Southeast Asia.
Mr. Metzgar
- HI 265 INDIA FROM ANTIQUITY TO THE PRESENT 3 (3-0) F
Prerequisite: Three hours history or advanced placement
The course is designed to acquaint the beginning student with the bases of Indian civilization both in its traditional forms and its modern development. Mr. Metzgar
- HI 272 THE AFRO-AMERICAN IN AMERICA 3 (3-0) F
After a brief consideration of his African background, the course considers the particular role, experience and influence of the Afro-American at various stages in the development of the United States.
Staff
- Note: Unless particular prerequisites are specified, the prerequisite for European history courses at the 300-400 level is HI 101-102 or equivalent (or consent of instructor); the prerequisite for American history courses at the 300-400 level is HI 111-112 or equivalent (or consent of instructor).*
- HI 301 ANCIENT GREEK CIVILIZATION 3 (3-0) F
The history of the Hellenes is traced from the Minoan civilization through Alexander's legacy, with readings in Herodotus and Thucydides.
Mr. Riddle
- HI 302 ROME TO 180 A. D. 3 (3-0) S
Tracing the development of Rome from the Etruscans through Emperor Marcus Aurelius (180 A.D.), this course examines critically the great political achievement which saw Rome rise from a cattle-town on the Tiber to the head of an Empire. This rise is examined through readings in Livy and Tacitus.
Mr. Riddle
- HI 306 NORTH CAROLINA HISTORY 3 (3-0) S
A study of the history of North Carolina from the earliest period of exploration and colonization to the present.
Mr. Noblin
- HI 321 INTERNATIONAL RELATIONS SINCE 1870 3 (3-0) F
A study of the relations between the major countries of the world since 1870. In addition to the history of actual diplomatic relations, crises and settlements, attention is given to the causes of the various international crises. The course also includes study of the development of international organizations and the various points of conflict between international law and organization and the sovereignty of independent governments.
Mr. Brown
- HI 328 THE AGE OF ABSOLUTISM 1650-1789 3 (3-0) S
This course will concentrate on the development of royal absolutism in 17th century Europe, the nature of the institutions which supported it, the particular cultural forms and patterns which it generated, and the reasons for its decline in the 18th century.
Mr. Greenlaw

HI 329 REVOLUTIONARY EUROPE, 1789-1815 3 (3-0) F

A broadly based analysis of Europe's first revolutionary era. Starts with the revolution in thought called the Enlightenment, then examines the causes and character of the Revolution in France, and finally traces the impact of these events in France and Europe. Mr. Greenlaw

HI 341 HISTORY OF TECHNOLOGY 3 (3-0) S

A survey of selected key developments in the field of technology from ancient to modern times. Staff

HI 343 COLONIAL AMERICA 3 (3-0) F

A study of the development of the American colonies in the 17th and 18th centuries with special emphasis on European backgrounds. Mr. Seegers

HI 344 THE UNITED STATES: REVOLUTION TO CONSTITUTION 3 (3-0) S

The historical steps in the establishment of the United States as an independent nation. The conflict with Great Britain after 1763 leading to the declaring of independence; the war for American independence in its military and diplomatic aspects; the domestic problems; the foreign relations in the post-war years; the establishment of government in the new nation. Mr. Seegers

HI 345 THE UNITED STATES: THE EARLY NATIONAL PERIOD 1789-1815 3 (3-0) F

A study of the political, social, economic, intellectual and diplomatic aspects of the history of the United States from the adoption of the Constitution in 1789 through the second Madison administration. The establishment of the federal government; the implementation of Hamilton's financial system; foreign affairs during the Wars of the French Revolution; the rise of political parties; the triumph of the Jeffersonian Republicans; the territorial expansion of the United States; the War of 1812. Mrs. Pulley

HI 346 THE UNITED STATES: THE MIDDLE PERIOD, 1815-1850 3 (3-0) S

The major political, economic, social and cultural developments from the Era of Good Feelings through the Jacksonian period to the Compromise of 1850. The relationship of these developments to the evolution of sectionalism is emphasized. Staff

HI 347 THE UNITED STATES: CIVIL WAR AND RECONSTRUCTION 1850-1877 3 (3-0) F

A study of the period of sectional strife and war, with an examination of the impact of the war on the United States and the efforts to reconstruct the South on a national basis. Mr. Harris

HI 348 EMERGENCE OF MODERN AMERICA 3 (3-0) S

An intensive study of the period from 1877 to 1914 with special emphasis on topics of lasting significance in United States history. Economic, social, cultural and political forces are balanced within a combined topical and chronological framework. Mr. Noblin

HI 351, 352 ENGLISH HISTORY 3 (3-0) F S

A study of the history of England from the earliest time to the present, stressing the evolution of the English constitution and the political, social and economic background of English cultural development. The semesters divide at 1603 and may be taken separately. Messrs. Carlton, Downs

HI 355 BRITISH EMPIRE AND COMMONWEALTH 3 (3-0) S

A history of the British Empire and Commonwealth in the 19th and 20th cen-

turies, stressing the evolution of colonial self-government and the transformation of imperial relationships in the former British dependencies in Canada, the West Indies, Africa, Asia and the Pacific Islands. Mr. Downs

HI 356 GERMANY SINCE 1848 3 (3-0) F

A history of Germany from the revolutions of 1848 to the present, concentrating on the problems of German nationalism and political and social reform. Mr. Suval

HI 370 (EC 370) THE RISE OF INDUSTRIALISM 3 (3-0) F

(See economics, page 283.)

HI 376 MODERN MEXICO 3 (3-0) S

Prerequisite: HI 215

A study of the major developments in Mexican national life since 1821. The first half of the course will deal with the 19th century: the era of Santa Anna, the war with the United States, the Reform, the French intervention, and the dictatorship of Porfirio Diaz. The second half will investigate the 1910 Revolution and the resulting transformation of Mexico's political, social and economic institutions. A reading knowledge of Spanish will be helpful but is not required. Mr. Bailey

HI 401 HISTORY OF RUSSIA TO 1881 3 (3-0) F

The major trends in Russian social, political, economic and cultural history prior to 1881. Mrs. Wheeler

HI 402 HISTORY OF RUSSIA SINCE 1881 3 (3-0) S

This course surveys the history of Russia and the Soviet Union from the great reforms of the 19th century to modern times, with emphasis on the political, religious and cultural trends that underlie the development of the Russian state and society and the position of the U.S.S.R. in the world today. Also includes Tsarist and Soviet foreign policy. Mrs. Wheeler

HI 407 FRANCE SINCE THE REVOLUTION 3 (3-0) F

An examination of the major trends in French history since the downfall of Napoleon I. Cultural, economic, social and intellectual trends are stressed as well as the political. The ways in which France has been a seedbed for new movements in Europe are particularly noted. Mr. Brown

HI 408 A CENTURY OF NATIONALISM: EAST CENTRAL EUROPE, 1848-1948 3 (3-0) S

A study of nationalistic movements, largely within the Austro-Hungarian, Russian, Ottoman and German Empires, for independent sovereignty, and with the attainment of these goals their continuing conflicts within and between the successor states and their roles in the conflicts of the great 20th-century forces. Mr. Brown

HI 412 RECENT UNITED STATES HISTORY 3 (3-0) S

An examination of the major political, economic, social and diplomatic problems in American history since 1917. Mr. Hobbs

HI 413 UNITED STATES FOREIGN RELATIONS SINCE 1898 3 (3-0) S

An examination of the origins of American foreign policy and the conduct of diplomacy in the era since the United States became a world power. Stress is given to the complex array of personalities, ideas, institutions and forces involved in shaping and implementing policy. Mr. Beers

HI 421 ANCIENT AND MEDIEVAL SCIENCE 3 (3-0) F

An introduction to the concepts and theories providing the foundations of science from the classical age until the close of the Middle Ages. Basic scientific ideas and systems are examined and their developments traced. Besides reviewing the early traditions, special emphasis is given to Aristotle, Ptolemy, the Atomists and the Impetus Theorists. Both Christian and Arab influences on science are evaluated. The course concludes with an analysis of the revolutionary contributions of Copernicus.

Mrs. Sylla

HI 422 RISE OF MODERN SCIENCE 3 (3-0) F S

The "Scientific Revolution" of the 16th and 17th centuries is presented, and Newton's System analyzed. The origins of modern chemistry, geology and evolution theory are discussed, and the radical revision of Newtonian theory in the 20th century is briefly described. These developments are always considered within the context of the great historic movements of their time.

Mrs. Sylla

HI 423 UNITED STATES INTELLECTUAL HISTORY 1600-1890 3 (3-0) S

The history of ideas in America from the 17th century to 1890. A consideration of the main traditions of thought as reflected in the writings of significant American figures and their relationship to major historical events and cultural changes.

Mrs. Pulley

HI 425 FROM REFORMATION TO REVOLUTION: ENGLAND 1529-1640 3 (3-0) S

A study of the permanent political crisis set into motion by the Reformation which culminates in the English Civil War. Primary emphasis will be given to certain key developments in social, political and economic life such as the development of a new concept of kingship, the growing independence of Parliament, the search for religious uniformity and the changing status of the aristocracy and gentry.

Mr. Carlton

HI 427 EUROPEAN INTELLECTUAL HISTORY 3 (3-0) S

Covering the period since the French Revolution this course examines major trends in European thought influencing the course of history. Special attention is given to the development of the social sciences. The growth of a distinct intellectual class and the role of its ideas in European political and social life is emphasized.

Mr. Suval

HI 462 (ED 462) HISTORY OF EDUCATION 3 (3-0) F

Prerequisite: HI 101, 102 or equivalent with consent of instructor

The course traces the development of educational institutions and practices and analyzes the ideas and influence of educational innovators and critics. Approximately equal time is given to each of the following areas: the Greeks to the Reformation, Modern Europe and the United States.

Mr. Noblin

HI 470 (EC 470) EVOLUTION OF THE AMERICAN ECONOMY 3 (3-0) S

(See economics, page 285.)

HI 471 REVOLUTIONARY CHINA 3 (3-0) F

Prerequisites: HI 263, HI 264 or consent of instructor

An intensive examination of the destruction of traditional China and the emergence of modern nationalism.

Mr. Metzgar

HI 472 MODERN JAPAN, 1850 TO PRESENT 3 (3-0) S

Prerequisites: HI 263, HI 264 or consent of instructor

An intensive examination of Japan's emergence as a nation and world power.

Mr. Metzgar

HI 474 MODERN INDIAN HISTORY**3 (3-0) S**

Prerequisite: HI 265

The course will explore some of the major questions raised by the development of modern Indian and Pakistani society. The problems of transition from colonial to independent status and the new problems raised by independence will be stressed.

Mr. Metzgar

HI 491 SEMINAR IN HISTORY**3 (3-0) F S**

Open to seniors majoring or concentrating in history. Open to other seniors and graduate students with departmental permission.

Staff

HI 492 SEMINAR IN HISTORY**3 (3-0) F S**

Required of all history majors. Usually to be taken in the spring of the senior year.

Staff

HI 498 SPECIAL TOPICS IN HISTORY**1-3 F S**

Prerequisites: Six hours history, consent of instructor

Students in the course will read extensively on special predetermined topics focused around a central theme. The topics and themes will vary each year depending on the particular interests and competence of the assigned professor.

Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES**HI 500 (BS 500) THE DEVELOPMENT OF CONTEMPORARY CONCEPTS IN BIOLOGY****3 (3-0)**

(See biological sciences, page 252.)

HI 505 THE ROMAN REVOLUTION, 133 B.C.-27 B.C.**3 (3-0) F**

Prerequisite: Six hours of European history above the introductory level or consent of department

An analysis of the economic, cultural and political factors which caused a breakdown of the Roman republican constitution.

Mr. Riddle

HI 506 HISTORY OF THE ROMAN EMPIRE, 27 B.C.-180 A.D.**3 (3-0) S**

Prerequisite: Six hours of European history above the introductory level or consent of department

The course traces the evolutionary development of the government of the empire from Augustus through Marcus Aurelius.

Mr. Riddle

HI 529 REVOLUTIONARY EUROPE, 1760-1792**3 (3-0) F**

Prerequisite: Six hours of European history above the introductory level or consent of department

An intensive study of the background of revolutionary ideas and events in Europe during the period indicated.

Mr. Greenlaw

HI 530 REVOLUTIONARY EUROPE, 1792-1815**3 (3-0) S**

Prerequisite: Six hours of European history above the introductory level or consent of department

An intensive study of revolutionary events in France and especially of their impact upon Europe in this period.

Mr. Greenlaw

HI 531 HISTORY OF GREAT BRITAIN, 1714-1820**3 (3-0) F**

Prerequisite: Six hours of European history above the introductory level or consent of department

A study in depth of constitutional, religious and economic ideas and institutions in 18th century Britain.

Mr. Downs

- HI 532 HISTORY OF GREAT BRITAIN, 1820-1914 3 (3-0) S
Prerequisite: Six hours of European history above the introductory level or consent of department
A study in depth of constitutional, religious and economic ideas and institutions of 19th century Britain. Mr. Downs
- HI 535 DIPLOMATIC HISTORY OF EUROPE, 1815-1878 3 (3-0) F
Prerequisite: Six hours of European history above the introductory level or consent of department
An analysis of the nature of European diplomatic relations from the Congress of Vienna to the Congress of Berlin. Mr. Brown
- HI 536 DIPLOMATIC HISTORY OF EUROPE, 1878-1939 3 (3-0) S
Prerequisite: Six hours of European history above the introductory level or consent of department
A study of diplomatic history of Europe from the Congress of Berlin through the reemergence of the system of balance of power and the repercussions of imperialism, the diplomatic aspects of the World Wars, and the attempts at solving world problems by means of diplomacy. Mr. Brown
- HI 545 THE AMERICAN CIVIL WAR, 1849-65 3 (3-0) F
Prerequisite: Six hours of American history
The course traces and analyzes events that led to the disruption of the union and provides an intensive study of the war, with emphasis upon its nonmilitary aspects. Only the major military campaigns are discussed. Mr. Harris
- HI 546 THE UNITED STATES DURING THE RECONSTRUCTION ERA, 1865-1880 3 (3-0) S
Prerequisite: Six hours of American history
This course is an in-depth study of the difficulties involved in the restoration and readjustment of American society after the Civil War. Special attention is given to social and economic conditions in the defeated South, military reconstruction and Republican ascendancy in the region. Mr. Harris
- HI 549 RECENT U.S. HISTORY, 1912-33 3 (3-0) F
Prerequisite: Six hours of American history or consent of department
An intensive examination of the major events in American life in the opening years of the 20th century. Mr. Noblin
- HI 550 RECENT U.S. HISTORY, 1933-PRESENT 3 (3-0) S
Prerequisite: Six hours of American history or consent of department
An intensive examination of the major events in American life in the middle years of the 20th century. Mr. Noblin
- HI 551 HISTORY AND PRINCIPLES OF THE ADMINISTRATION OF ARCHIVES AND MANUSCRIPTS 3 (3-0) F
Prerequisite: Six hours of American history or consent of department
A study of the nature, importance and use of original manuscript resources; the history and evolution of written records and the institutions administering them. Mr. Jones
- HI 552 APPLICATION OF PRINCIPLES OF ADMINISTRATION OF ARCHIVES AND MANUSCRIPTS 3 (3-0) S
Prerequisite: Six hours of American history or consent of department
Internship training in the application of the principles and practices of archival management. Mr. Jones

- HI 561 U.S. FAR EASTERN POLICY, 1842-1922 3 (3-0) F
Prerequisite: Six hours of American history or consent of department
A study of the character and development of the basic principles of American policy in the Far East from their origin to their incorporation in treaties at the Washington Disarmament Conference. Mr. Beers
- HI 562 U.S. FAR EASTERN POLICY, 1922-PRESENT 3 (3-0) S
Prerequisite: Six hours of American history or consent of department
A study of the character and development of the basic principles of American policy in the Far East from the end of World War I to the present. Mr. Beers
- HI 563 SOCIAL AND ECONOMIC HISTORY OF THE UNITED STATES TO 1860 3 (3-0) F
Prerequisite: Six hours of American history or consent of department
A study of the social and economic ideas and institutions important in American life from the colonial period up to the Civil War. Miss King
- HI 564 SOCIAL AND ECONOMIC HISTORY OF THE UNITED STATES SINCE 1860 3 (3-0) S
Prerequisite: Six hours of American history or consent of department
A study of the social and economic ideas and institutions important in American life since the beginning of the Civil War. Miss King
- HI 565 THE HISTORY OF URBAN LIFE IN THE UNITED STATES 1607-1865 3 (3-0) F
Prerequisite: Six hours U.S. history including HI 111 or consent of instructor
The history of urban life in the United States, 1607-1865. This course is designed primarily to give the student an understanding of the historical background of today's urban problems. Miss King
- HI 566 THE HISTORY OF URBAN LIFE IN THE UNITED STATES, 1865-PRESENT 3 (3-0) S
Prerequisite: Six hours of U.S. history including HI 112 or consent of instructor
The history of urban life in the United States, from 1865 to present. This course is designed primarily to give the student an understanding of the historical background of today's urban problems. Miss King
- HI 571 HISTORY OF SOVIET RUSSIA TO 1930 3 (3-0) F
Prerequisite: Six hours of European history above the introductory level or consent of department
An analysis of the origins and effects of the 1917 revolutions and the domestic and foreign policies of the new Soviet regime to 1930. Mrs. Wheeler
- HI 572 HISTORY OF SOVIET RUSSIA SINCE 1930 3 (3-0) S
Prerequisite: Six hours of European history above the introductory level or consent of department
An analysis of the domestic and foreign policies of the Soviet Union since 1930 with special emphasis on the period since 1945. Mrs. Wheeler

FOR GRADUATES ONLY

- HI 601 HISTORIOGRAPHY AND HISTORICAL METHOD 3 (3-0) F
- HI 602 SEMINAR IN AMERICAN HISTORY 3 (3-0) S
- HI 604 SEMINAR IN EUROPEAN HISTORY 3 (3-0) S

HORTICULTURAL SCIENCE

FOR UNDERGRADUATES

HS 201 PRINCIPLES OF HORTICULTURE

3 (3-0) F S

Attention will be directed to the basic principles involved in the application of these principles to the production, processing and utilization of fruit, vegetable and ornamental crops. Attention will also be given to the economic importance and distribution of horticultural enterprises.
Mr. Cochran

HS 211, 212 ORNAMENTAL PLANTS

3 (1-5) F S

Prerequisite: BS 100

Distribution, botanical characters and relationships, adaptation and usage of ornamental trees, shrubs, vines and herbaceous plants.
Mr. Southall

HS 301 PLANT PROPAGATION

3 (2-2) S

Prerequisite: BS 100

A study of principles, methods and practices in seedage, cuttage, division, budding, grafting and other methods of propagation. Consideration will also be given to scion and stock relationships and dormancy.
Mr. Nelson

HS 342 LANDSCAPE HORTICULTURE

3 (2-3) F

The application of the principles of design to the landscaping of small properties and the selecting and planting of trees, shrubs, flowers and lawn grasses. Students will be required to work out detailed landscape plans. Visitations will be made to outstanding homes and gardens.
Mr. Halfacre

HS 411 NURSERY MANAGEMENT

3 (2-3) F

Prerequisites: BS 100, SSC 200

The principles and practices involved in the production, management and marketing of field-grown and container-grown nursery plants. Field trips will be taken.
Mr. Cannon

HS 414 RESIDENTIAL LANDSCAPING

4 (2-6) F

Prerequisites: E 101, SSC 200, HS 211, HS 212

The landscape planning and development of residential properties to create an aesthetical and functional landscape composition to complement the home. Students will be required to complete planting plans, including design, plant lists, planting details and technical specifications.
Mr. Halfacre

HS 421 FRUIT PRODUCTION

3 (2-3) F

Prerequisites: BS 100, SSC 200

A study of identification, adaptation and methods of production and marketing of the principal tree and small fruits. Modern practices as related to selection of sites, nutritional requirements, management practices and marketing procedures will be discussed.
Mr. Correll

HS 432 VEGETABLE PRODUCTION**3 (2-3) F****Prerequisites:** BS 100, SSC 200

A study of the origin, importance, distribution, botanical relationships and principles of production and marketing of the major vegetable crops. Mr. Miller

HS 441 FLORICULTURE I**3 (2-3) F****Prerequisites:** BS 100, SSC 200

The scope and importance of the commercial flower industry; the basic principles and practices involved in the production and marketing of flowers grown in the greenhouse and in the field. (Offered fall, 1971 and alternate years.)

Mr. Larson**HS 442 FLORICULTURE II****3 (2-3) S****Prerequisites:** BS 100, SSC 200

Principles and methods of production of commercial flower crops in the greenhouse and in the field including fertilization, moisture, temperature and light relationships, insect and disease control, and marketing of cut flowers and pot plants. (Offered spring, 1972 and alternate years.)

Mr. Larson**HS 471 ARBORICULTURE****3 (2-2) S****Prerequisites:** BS 100, SSC 200

A study of the principles and practices in the care and maintenance of ornamental trees and shrubs, such as pruning, fertilization, control of insects and diseases, and tree surgery. Field trips will be taken. (Offered spring, 1972 and alternate years.)

Mr. Cannon**HS 491 SENIOR SEMINAR IN HORTICULTURAL SCIENCE****1 (1-0) F S****Prerequisite:** Consent of department

Presentation of scientific articles, progress reports in research, and special problems in horticulture and related fields. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES**HS 514 (CS 514) PRINCIPLES AND METHODS IN WEED SCIENCE****3 (2-2) S****Prerequisite:** CS 414 or equivalent

Studies of the losses caused by weeds, the ecology of weeds, biological control, basic concepts of weed management, herbicide-crop relationships and herbicide development. Introduction to greenhouse and bioassay techniques used in herbicide work and to field research techniques supplemented by laboratory and field exercises.

Messrs. Monaco, Schrader**HS 521 (FS 521) FOOD PRESERVATION****3 (2-3) F****(See food science, page 319.)****HS 541 (GN 541, CS 541) PLANT BREEDING METHODS****3 (3-0) F****(See crop science, page 279.)****HS 542 (GN 542, CS 542) PLANT BREEDING FIELD PROCEDURES****2 (0-4) Sum.****(See crop science, page 279.)****HS 552 GROWTH OF HORTICULTURAL PLANTS****3 (2-3) F****Prerequisite:** BO 421

A study of the effect of nutrient elements, water, light, temperature and growth substances on horticultural plants. Mr. McCombs

HS 562 (FS 562) POST-HARVEST PHYSIOLOGY

3 (3-0) S

Prerequisite: BO 421

A study of chemical and physiological changes that occur during handling, transportation and storage which affect the quality of horticultural crops. Consideration will be given to pre- and post-harvest conditions which influence these changes.

Mr. Ballinger

HS 599 RESEARCH PRINCIPLES

Credits Arranged

Prerequisite: Consent of instructor

Investigation of a problem in horticulture under the direction of the instructor. The students obtain practice in experimental techniques and procedures, critical review of literature and scientific writing. The problem may last one or two semesters. Credits will be determined by the nature of the problem, not to exceed a total of four hours.

Graduate Staff

FOR GRADUATES ONLY**HS 613 (CS 613, GN 613) PLANT BREEDING THEORY**

3 (3-0) S

HS 614 (CS 614, SSC 614) HERBICIDE BEHAVIOR IN PLANTS AND SOILS

3 (3-0) F

HS 621 METHODS AND EVALUATION OF HORTICULTURAL RESEARCH

3 (3-0) F

HS 622 MINERAL NUTRITION IN PLANTS

3 (2-3) S

HS 691 SEMINAR

1 (1-0) F S

HS 699 RESEARCH

Credits Arranged

INDUSTRIAL AND TECHNICAL EDUCATION**FOR UNDERGRADUATES****ED 100 INTRODUCTION TO INDUSTRIAL EDUCATION**

2 (2-0) F

The place of vocational education in a program of public education and the fundamental principles upon which this work is based.

Mr. Miller

ED 305 ANALYSIS OF TECHNICAL EDUCATION PROGRAMS AND COURSE CONSTRUCTION

3 (3-0) S

Prerequisites: ED 100, advanced undergraduate standing

Principles and techniques of selecting and analyzing suitable teaching activities and arranging such material into a functional instructional order. Instructional units prepared will be based on an analysis of a technical occupation or activity. A detailed course of study will be prepared.

Mr. Shore

ED 327 HISTORY AND PHILOSOPHY OF INDUSTRIAL AND TECHNICAL EDUCATION

3 (3-0) F

Prerequisite: ED 100

Historical study of trade and technical education movement. Place, function and changing concepts of industrial and technical education in American education. Economic, sociological and psychological aspects.

Mr. Nerden

- ED 405 INDUSTRIAL AND TECHNICAL EDUCATION SHOP AND LABORATORY PLANNING 3 (3-0) F
Prerequisites: Senior standing, six hrs. of drawing and design
Principles and techniques to assist teachers in planning and organizing shop and laboratory facilities. Problems of locating and equipping vocational schools; the planning and layout of shops and related technology laboratories and classrooms. Individual and group assignments on planning and layout of postsecondary school buildings. Mr. Shore
- ED 421 PRINCIPLES AND PRACTICES IN INDUSTRIAL COOPERATIVE TRAINING 3 (3-0) F S
Prerequisites: ED 327, ED 344
A study of the developments, objectives and principles of industrial cooperative training. The organization, promotion and management of programs in this area of vocational education. Mr. Smith
- ED 422 METHODS OF TEACHING INDUSTRIAL SUBJECTS 3, 4(3-2) F
Prerequisites: ED 344, PSY 304
A study of effective methods and techniques of teaching industrial subjects. Emphasis is given to class organization; student-teacher planning; methods of teaching manipulative skills and related information; lesson planning; shop safety; and evaluation. Teaching problems will be studied and analyzed following directed observations in the public schools. Staff
- ED 428 ORGANIZATION OF RELATED STUDY MATERIALS 3 (3-0) F S
Prerequisites: ED 327, ED 344
The principles of selecting and organizing both technical and general related instructional material for trade extension and industrial cooperative training classes. Mr. Smith
- ED 440 VOCATIONAL EDUCATION 2 (2-0) F
Prerequisites: ED 344, PSY 304
A comprehensive study of the types of vocational education of less than college grade, provided for through federal legislation; an evaluation of the effectiveness of the program; and a detailed study of the North Carolina Plan. Staff
- ED 444 STUDENT TEACHING IN INDUSTRIAL SUBJECTS 6 (2-15) F
Prerequisites: ED 344, PSY 304, senior standing, admission to teacher education and an overall 2.0 average.
Students in the industrial arts, vocational industrial education and technical education curricula will devote 10 weeks during the fall semester to full-time, off-campus student teaching in selected public schools throughout the State. They will be assigned to their teaching center in the preceding spring and will report to their supervising teachers when the public schools (to which they are assigned) open in the fall. During the remainder of the term, additional courses will be taken in concentrated form. Staff
- ED 482 CURRICULUM PROBLEMS IN INDUSTRIAL ARTS 2 (1-2) S
Prerequisite: PSY 304 or six hours education
This course is devoted to planning and organizing learning units in industrial arts. Staff
- ED 483 INSTRUCTIONAL AIDS AND DEVICES 2 (1-2) F
Prerequisite: PSY 304 or six hours education
Analysis of learning units and the preparation of industrial instructional aids and devices. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 516 COMMUNITY OCCUPATIONAL SURVEYS 2 (2-0) S

Prerequisites: Six hours education, consent of instructor

Methods in organizing and conducting local surveys and evaluation of findings in planning a program of vocational education. Graduate Staff

ED 517 IMPLICATIONS FOR DATA PROCESSING IN EDUCATION 3 (3-0) F S

Prerequisites: CSC 111; ED 529 or consent of instructor

An intensive study of current attempts to apply new technologies to education. Attention will be given to research findings related to Computer Assisted Instruction, gamed instructional simulation, approaches to guidance and prescription learning as well as administrative problems pertaining to student scheduling, pupil transportation and data reporting systems. Graduate Staff

ED 525 TRADE ANALYSIS AND COURSE CONSTRUCTION 3 (3-0) F

Prerequisites: ED 344, PSY 304

Principles and practices in analyzing occupations for the purpose of determining teaching content. Practice in the principles underlying industrial course organization based on occupational analysis covering instruction in skills and technology and including course outlines, job sequences, the development of industrial materials and instructional schedules. Graduate Staff

ED 527 PHILOSOPHY OF INDUSTRIAL AND TECHNICAL EDUCATION 3 (3-0) F S

Prerequisites: ED 422, ED 440

A presentation of the historical development of industrial and technical education; the types of programs, philosophy, trends and problems of vocational-industrial education; study of federal and state legislation pertaining to industrial education, practical nurse education and technical education. Mr. Nerden

ED 529 CURRICULUM MATERIALS DEVELOPMENT 3 (3-0) S

Prerequisite: ED 525

Selection and organization of curricula used in vocational-industrial and technical education; development of curricula and instructional materials. Mr. Hanson

ED 552 INDUSTRIAL ARTS IN THE ELEMENTARY SCHOOL 3 (3-0) Sum.

Prerequisites: 12 hours education, consent of instructor

This course is organized to help elementary teachers and principals understand how tools, materials and industrial processes may be used to vitalize and supplement the elementary school child's experience. Practical children's projects along with the building of classroom equipment. Staff

ED 555 COMPARATIVE CRAFTS AND INDUSTRIES 6 Sum.

Prerequisites: Advanced undergraduate or graduate standing, consent of instructor

A travel seminar as a cultural appreciations course involving study of indigenous crafts and industries, their materials, processes, products and design in foreign countries. Mr. Olson

ED 591 SPECIAL PROBLEMS IN INDUSTRIAL EDUCATION Maximum 6

Prerequisites: Six hours graduate credit, consent of department head

Directed study to provide individualized study and analysis in specialized areas of trade, industrial or technical subjects. Graduate Staff

FOR GRADUATES ONLY

ED 608	SUPERVISION OF VOCATIONAL AND INDUSTRIAL ARTS EDUCATION	3 (3-0) F
ED 609	PLANNING AND ORGANIZING TECHNICAL EDUCATION PROGRAMS	3 (3-0) S
ED 610	ADMINISTRATION OF VOCATIONAL AND INDUSTRIAL ARTS EDUCATION	3 (3-0) S
ED 611	LAWS, REGULATIONS, AND POLICIES AFFECTING VOCATIONAL EDUCATION	3 (3-0) F S
ED 612	FINANCE, ACCOUNTING AND MANAGEMENT OF VOCATIONAL EDUCATION PROGRAMS	3 (3-0) F S
ED 630	PHILOSOPHY OF INDUSTRIAL ARTS	2 (2-0) F S
ED 635	ADMINISTRATION AND SUPERVISION OF INDUSTRIAL ARTS	2 (2-0)
ED 691	SEMINAR IN INDUSTRIAL EDUCATION	1 (1-0)
ED 692	SEMINAR IN INDUSTRIAL ARTS EDUCATION	1 (1-0) F S
ED 699	RESEARCH	Credits Arranged

INDUSTRIAL ARTS

FOR UNDERGRADUATES

IA 100	INTRODUCTION TO INDUSTRIAL ARTS	1 (1-0) F
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A basic course designed to orient the student to college life and to introduce him to the philosophy, objectives and scope of industrial arts as related to teacher education and industrial employment. A study of the problems and opportunities in the profession.

Staff

IA 102	FUNDAMENTALS OF MATERIALS AND PROCESSES	4 (2-4) F S
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A systematic study of the structure and characteristics of selected materials and the processes utilized in shaping, forming, cutting, machining and finishing them into products. Attention will be given to the requirements of manufacturing of products. Experiences in graphic communication, demonstrations of hand and machine tools, and student participation in laboratory problems in the identification and testing of materials will be provided.

Staff

IA 103	DRAFTING I	3 (1-4) S
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Service course for agricultural education.

Graphical communication encompassing sketching and instrument drawing. Theory and practice taught through the medium of freehand sketching involving oblique, isometric, perspective, exploded, assembly, sections and orthographic projection type drawings. Also included is blackboard sketching.

Mr. Troxler

IA 105	DRAFTING	4 (2-4) F S
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Prerequisite: IA 102

This course covers theory and practice in the area of technical communication

through the sketching and drafting media. The student will get practice in both sketching and instrument drawing in the orthographic projection, pictorial drawing, sections, revolutions and sheet metal development. Mr. Troxler

IA 203 TECHNICAL SKETCHING 2 (1-2) S

The application of drawing practices for the layman. Freehand sketching, pictorial representation, production sketches, template drawing, exploded views, shades and shadows. Individual problems and selected graphic representation. Mr. Troxler

IA 205 INDUSTRIAL ARTS DESIGN 3 (1-4) F S
Prerequisites: IA 100, IA 209, IA 210

A study of design as related to industry and the industrial arts laboratory. Creative design and individual expression through problems involving utilization of industrial material for human needs. Mr. Troxler

IA 209 WOOD PROCESSING 4 (2-4) F S
Prerequisite: IA 102

This course is designed to provide an orientation to the processes of designing, developing and producing wood products through lectures, discussions and planned experiences in the various woodworking areas. Emphasis will be on planning and developing wood products in the industrial arts laboratory, together with an analysis of typical products and industrial practices. A research report will be required. Staff

IA 210 METAL TECHNOLOGY 4 (2-4) F S
Prerequisites: IA 102, IA 105

This course is designed to provide an orientation to the process of designing, developing and producing metal products. Instruction will be given through lectures, discussions and planned experiences in the basic metal-working areas. Emphasis will be on planning and developing of metal products in the industrial arts laboratory, coupled with analysis of typical products and industrial practices. A research report will be required. Mr. Moeller

IA 230 DRAFTING II 3 (1-4) S
Prerequisite: IA 105

This is a depth course in drawing. The student will have laboratory exercises in problem solutions through the drawing method. The skill of application and utilization of drawing as a means of communication will be emphasized. Mr. Troxler

IA 304 GENERAL SHOP ORGANIZATION 2 (1-2) S
Prerequisites: IA 105, IA 209, IA 210, IA 312

Application of principles of general shop organization and operation. Analysis of products. Methods and techniques of production of laboratory projects including a variety of materials suitable to varying educational levels. Mr. Young

IA 306 GRAPHIC ARTS 4 (2-4) S
Prerequisite: IA 102

An introduction to the basic printing areas of letterpress, offset, photography, silk screen and bookbinding with emphasis on course outline and subject matter for the secondary schools. Mr. Moeller

IA 312 ELECTRICITY-ELECTRONICS 4 (3-3) F S
Prerequisites: PY 211, PY 212 or consent of instructor

A study of the principles of electricity and electronics, basic principles; AC and DC circuits; electrical machinery; and electronics, including power supplies, amplifiers, oscillators and tuned circuits. Applications and examples of the com-

mon experiences which the student encounters such as power and light circuits, motors and controls, measuring and servicing instruments, power supplies, amplifiers, radios and electronic control circuits. Mr. Young

IA 315 GENERAL CERAMICS

3 (1-4) S

This course is designed to give the student an opportunity to work with ceramic materials as a medium of expression and to get experience in the basic manufacturing processes of the ceramic industry. Emphasis will be given to a study of the sources of clay, designing, forming, decorating and firing of ceramic products. Mr. Olson

IA 321 MATERIALS TECHNOLOGY

3 (1-4) F S

Prerequisites: IA 102, IA 210

An overview of selected industrial processes and new developments in materials and process application. Emphasis is given to fundamental principles of industrial practices concerned with manufacturing. A research problem involving individual investigation in a specific process and materials area is required. Mr. Moeller

FOR ADVANCED UNDERGRADUATES

IA 412 ELECTRICAL PRACTICUM

3 (1-4) S

Prerequisite: IA 312 or equivalent

A study of design, layout and construction of basic apparatus in the fields of electricity and electronics. Special emphasis upon the use of the tools and hardware used in the electrical trades. Mr. Young

IA 465 INDEPENDENT STUDY IN INDUSTRIAL ARTS

Maximum 6

Prerequisite: Senior standing

A course designed to develop problem-solving ability through research activities in industrial arts. Problems in industrial arts curriculum, method and content are carefully selected, designs or plans of action are prepared, and final papers are presented and defended before a faculty committee. Staff

IA 480 MODERN INDUSTRIES

3 (3-0) F S

Prerequisite: Senior standing

An overview of the function and organization of modern industry. Principles of work simplification, motion economy, processing and scheduling are reviewed. The effects of technological change on labor, management and consumer are considered. Attention will be focused on contributions of technology to specific industrial processes in machining, forming, fabricating in relationship to principles, types of equipment and usage areas. Mr. Young

IA 484 SCHOOL SHOP PLANNING AND EQUIPMENT SELECTION

3 (3-0) F

The physical planning of school shops and laboratories; selection of tools and equipment. Whenever possible, actual contemplated school buildings will be used for class work. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

IA 510 DESIGN FOR INDUSTRIAL ARTS TEACHERS

3 (2-2) Sum.

Prerequisites: Six hours drawing, IA 205 or equivalent

A study of new developments in the field of design with emphasis on the relationship of material and form in the selection and designing of industrial arts projects. Graduate Staff

**IA 560 (ED 560) NEW DEVELOPMENTS IN INDUSTRIAL ARTS
EDUCATION**

3 (3-0) F S

Prerequisites: 12 hours education, teaching experience

This course is a study of the new developments in industrial arts education. It is designed to assist teachers and administrators in developing new concepts and new content based on the changes in technology. They will be required to reevaluate their programs in the light of these new concepts and the new content. Mr. Olson

IA 590 LABORATORY PROBLEMS IN INDUSTRIAL ARTS

Maximum 6

Prerequisites: Senior standing, consent of instructor

Courses based on individual problems and designed to give advanced majors in industrial arts education the opportunity to broaden or intensify their knowledge and abilities through investigation and research in the various fields of industrial arts, such as metals, plastics or ceramics. Graduate Staff

IA 592 SPECIAL PROBLEMS IN INDUSTRIAL ARTS

Maximum 6

Prerequisite: One term of student teaching or equivalent

The purpose of these courses is to broaden the subject matter experiences in the areas of industrial arts. Problems involving experimentation, investigation and research in one or more industrial arts areas will be required. Graduate Staff

IA 595 (ED 595) INDUSTRIAL ARTS WORKSHOP

3 (3-0) Sum.

Prerequisite: One or more years of teaching experience

A course for experienced teachers, administrators and supervisors of industrial arts. The primary purpose will be to develop sound principles and practices for initiating, conducting and evaluating programs in this field. Enrollees will pool their knowledge and practical experiences and will do intensive research work on individual and group programs. Graduate Staff

FOR GRADUATES ONLY

IA 645 TECHNOLOGY AND INDUSTRIAL ARTS

3 (3-0)

IA 660 (ED 660) INDUSTRIAL ARTS CURRICULUM

3 (3-0)

INDUSTRIAL ENGINEERING

IE 241 FURNITURE MANUFACTURING PROCESSES I

3 (3-0) S

Prerequisite: E 240

A survey of furniture manufacturing technology. Emphasis is on equipment and its relationship to furniture product engineering. Mr. Clark

IE 301 ENGINEERING ECONOMY

3 (3-0) FS

Prerequisite: Junior standing

Not open to students scheduling IE 311.

Criteria and techniques of engineering economy for management decisions in relation to economy of design, economy of selection and economy of operation. Study of effects of depreciation policies and machine replacement considerations. Emphasis on problem solving and development of detailed project economy studies.

Staff

IE 311 ENGINEERING PROJECT ANALYSIS

3 (3-0) F

Prerequisite: Sophomore standing

An introduction to the organizational and production problems of industry with

emphasis on the development and use of analytical methods for the evaluation of engineering alternatives. Mr. Bernhard

IE 321 BUSINESS DATA PROCESSING

3 (2-2) FS

Prerequisite: CSC 111

The nature, flow, characteristics and handling of business data; classifying, sorting and calculating using unit record and simple business machines; collection for processing data on digital computers; information storage and retrieval, filing systems; computer programming of business problems, report generation, integration of data flows. Course will emphasize programming of several small projects and one major project on the campus computer equipment. Selection and balancing of computer systems.

Mr. Llewellyn & Staff

IE 322 FURNITURE DESIGN AND CONSTRUCTION I

2 (0-6) F

Prerequisites: IE 224, WPS 201

An introduction to furniture drawing and construction. Detailed drawings and bills of material are made by the students from samples and from designer's sketches. In construction, emphasis is placed upon satisfactory performance under variable atmospheric moisture, upon adequate strength and rigidity and upon low cost. (This course will be phased out by June 1972.)

IE 326 FURNITURE MANUFACTURE AND PROCESSING

4 (3-3) S

Prerequisites: IE 322, WPS 301

Corequisite: IE 332

A study of the production methods of the furniture industry. Class work includes the production procedures from the yard through the machine, cabinet, finishing, upholstering and shipping departments. The laboratory period is supplemented by visits to furniture plants. Particular attention is paid to production rates by departments, based on number of men and supervisors, the quality of products produced, and equipment used. (Not available after spring, 1971.)

IE 328 MANUFACTURING PROCESSES

3 (2-3) S

Prerequisite: MAT 201

The forming, finishing and joining operations used in the manufacture of industrial products of metallic and nonmetallic materials are treated. Principles and methods of measuring and gaging for quality assurance and for interchangeability in volume production are discussed. Laboratory work deepens the understanding of the lecture material and guides the student toward analytical thinking and reporting. Throughout the course the technical, supervisory and economic functions of the manufacturing engineer are emphasized.

Mr. Kamal

IE 332 MOTION AND TIME STUDY

4 (3-3) F S

Prerequisite: ST 361

Principles and techniques of motion and time study; detailed study of charting operator movements; micromotion study. Predetermined time data and its applications; stopwatch time study with emphasis on rating, allowances and standard data theory and practice.

Mr. Siphron

IE 340 FURNITURE MANUFACTURING PROCESSES II

3 (2-3) F

Prerequisites: IE 241, WPS 209

A survey of furniture manufacturing technology. Emphasis is on sequence of operations, production rates and the integration of many types of equipment into a manufacturing system.

Mr. Prak

IE 341 FURNITURE PLANT LAYOUT AND DESIGN

3 (2-3) S

Prerequisite: IE 326

Problems in industrial plant design with special reference to furniture manufacture; building structures, equipment location, space utilization, layout for opera-

tion and control; allied topics in power utilization, light, heat, ventilation and safety. Mr. Prak

IE 343 PLANT LAYOUT AND MATERIALS HANDLING 3 (1-4) FS
Prerequisites: IE 328, IE 332

Problems in plant arrangement and layout to obtain most effective utilization of men, materials and machines as related to space and costs. Includes consideration of heat, light ventilation, organization, control, material flow and handling, working conditions, safety and other factors as they affect the most satisfactory layout of the plant. Mr. Alvarez

IE 345 PRINCIPLES OF UPHOLSTERING 2 (2-0) S
Prerequisite: IE 322

Properties of seating equipment: evaluation of these properties. Introduction in the technology of flexible foam materials; slab foam; molded foam; stress-strain diagrams; compression set; evaluation tests. Properties of coil springs. Properties of fibrous filling materials. Upholstering constructions. Testing of upholstered furniture. Manufacturing procedures. Cost aspects. Mr. Prak

IE 346 FURNITURE DESIGN AND CONSTRUCTION II 2 (2-0) S
Prerequisite: IE 322

Lecture and laboratory work on the design and construction of modern and period furniture. The course emphasizes construction features that are economical of labor and materials and are adaptable to mass production. The course covers the use of new engineering materials and their effect on furniture construction. Mr. Clark

IE 351 PRODUCT AND PROCESS ENGINEERING 3 (2-3) F

A study of the selection of materials and processes required in the manufacture of component parts and assembled products. Included will be the study of the inter-relationship of product design, materials selected and processes employed in manufacturing operations. Project work will include application of basic principles in typical manufacturing processes. Capabilities and limitations of typical manufacturing equipment and processes will be stressed. Mr. Harder

IE 352 WORK ANALYSIS AND DESIGN 4 (2-6) S
Prerequisite: A course in mathematical statistics

A study of the production processes and work methods for the purpose of improving manpower utilization, reducing human effort and reducing the costs of production. This includes techniques successfully applied in industry such as operations sequencing, operations analysis, man-machine combinations, motion economy, predetermined motion standards, time study, elemental standard data, production line balancing, manufacturing progress function, lot evaluation, wage incentives and administrative functions. Mr. Biggane

IE 353 STATISTICAL QUALITY CONTROL 3 (3-0) S
Prerequisite: A course in mathematical statistics

An introduction to statistical techniques applied to industrial problems, including control of industrial systems, and decision-making under uncertainty. Included will be a thorough discussion of control chart techniques applied to control of industrial processes as well as an introduction to the extension of these techniques to the control of other industrial systems. Mr. Prak

IE 354 HUMAN FACTORS ENGINEERING 3 (2-2) S
Corequisite: IE 352

The course is designed for IE majors. The material covers basic anatomy and physiology with emphasis on how to use this knowledge in designing equipment;

systems analysis from the standpoint of the operator; the use of anthropometric data in designing equipment; and design and layout of displays, controls and work-spaces. Mr. Soliday

IE 361 QUANTITATIVE METHODS IN INDUSTRIAL ENGINEERING 3 (3-0) F
Prerequisite: MA 301

Introduction of the mathematical tools used in the formulation and solution to problems arising in industrial engineering. Topics include linear algebra, techniques in maxima and minima and the use of Laplace and Z-transforms. Applications of these techniques will be stressed. Mr. Magazine

IE 401 INDUSTRIAL ENGINEERING ANALYSIS I 3 (3-0) F
Prerequisites: IE 353; IE 361 or MA 405

A study of linear programming methods and their applications in industrial engineering; the transportation method with applications to scheduling in transportation and production problems; the simplex method and its application in production planning, production scheduling and allied fields; upper bound, integer, parametric and primal-dual methods with their typical applications; the interrelationships between linear programming and game theory. Mr. Nuttle

IE 402 INDUSTRIAL ENGINEERING ANALYSIS II 3 (3-0) S
Prerequisite: IE 401

An introductory study of several aspects of operations research methods with emphasis on their industrial engineering applications; replacement theory, sequencing problems, inventory control methods and dynamic programming and their applications. Mr. Nuttle

IE 403 INDUSTRIAL ENGINEERING ANALYSIS III 3 (3-0) S
Prerequisite: IE 401

An introductory study of several aspects of operations research methods with emphasis on their industrial engineering applications; continuous and discrete cybernetics with emphasis on Markov processes; finite and infinite queuing models; industrial control methods and industrial dynamics. Mr. Magazine

IE 408 PRODUCTION CONTROL 3 (2-3) S
Prerequisite: Senior standing

Planning, scheduling and dispatching of production in manufacturing operations; conversion of sales requirements into production orders; construction of production budgets and their relation to labor, materials and machines; laboratory project involving the development and operation control system of a typical plant. Mr. Bennington

IE 420 MANUFACTURING CONTROLS 3 (3-0) FS
Prerequisite: IE 301

Theory and methodology for developing and maintaining profitable manufacturing operations. Development of principles and procedures for control of materials, manpower and costs. Special attention to production and inventory control, equipment utilization, wage classification and cost reduction programs. Mr. Tucker

IE 421 DATA PROCESSING AND PRODUCTION CONTROL SYSTEMS 3 (3-0) F
Prerequisites: CSC 111, IE 352

This course is an introduction to the design of integrated control systems necessary for effective management of production. It will include the methods of systems design, the basic concepts of computer processing systems, the design of control procedures and reports, and their application to mechanized and electronic data processing equipment. Major emphasis will be placed on the design of control procedures for production scheduling, labor performance, quality control. Systems

flow charts, block diagrams and program statements in compiler form will be used for each system application. Mr. Llewellyn

IE 440 FURNITURE MANAGEMENT ANALYSIS 3 (1-4) F
Prerequisite: IE 341

A course in economic decision making applied to the furniture industry. The selection of equipment, materials, methods and strategy, from several feasible alternatives is studied with the aid of actual case histories. Mr. Prak

IE 441 (PSY 441) HUMAN FACTORS IN EQUIPMENT DESIGN 3 (2-2) F S
(See psychology, page 420.)

IE 443 QUALITY CONTROL 3 (2-2) FS
Prerequisite: ST 361

Economic balance between cost of quality and value of quality, and techniques for accomplishing this balance. Organization for, specification and utilization of quality controls. Statistical theory and analyses as applied to sampling, control charts, tolerance determination, acceptance procedures and control of production. Mr. Anderson

IE 453 OPERATIONS PLANNING AND PLANT LAYOUT 3 (2-3) F
Prerequisite: IE 352

This course will provide an opportunity for the student to apply the basic principles contained in the prerequisite courses to the design of plant-wide production programs with emphasis placed on planning, arrangement layout and implementation of such programs. It will include operations sequencing, tooling and equipment selection, materials handling, systems design, manpower and facilities forecasting. Suitable cases will be drawn from both mass production and jobbing operations. Mr. Biggane

IE 491, 492 SEMINAR IN INDUSTRIAL ENGINEERING 1 (1-0) FS

A weekly meeting of senior students to assist the transition from a college environment to that of industry. Lectures, problems, presentation of papers and outside speakers. Employment practices and procedures useful in job finding. (Not available after spring, 1972.) Mr. Anderson

IE 495 PROJECT WORK IN INDUSTRIAL ENGINEERING 2-6 FS
Prerequisite: Senior standing

Special investigations and research related to furniture construction and processing, and other assigned problems. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

IE 505 (MA 505, OR 505) MATHEMATICAL PROGRAMMING I 3 (3-0) F
Prerequisite: MA 405

A study of mathematical methods applied to problems of planning. Linear programming will be covered in detail. This course is intended for those who desire to study this subject in depth and detail. It provides a rigorous and complete development of the theoretical and computational aspects of this technique as well as a discussion of a number of applications. Messrs. Alvarez, Llewellyn

IE 509 (OR 509) DYNAMIC PROGRAMMING 3 (3-0) S
Prerequisites: MA 405, ST 421

An introduction to the theory and computational aspects of dynamic programming and its application to sequential decision problems. Mr. Nuttle

IE 511 ADVANCED ENGINEERING PROJECT ANALYSIS 3 (3-0) F
Prerequisites: IE 311, ST 421

Analysis of project economy models with certainty assumed; advantages and limitations of models, effects of income tax and depreciation methods. Risk analyses employing probability concepts; sensitivity studies and measure of utility. Estimation techniques and use of accounting information, time series analysis and judgment factors. Planning and uses of capital funds. Mr. Bernhard

IE 515 PROCESS ENGINEERING 3 (3-0) F
Prerequisites: IE 328, IE 443

The technical process of translating product design into a manufacturing program. The application of industrial engineering in the layout, tooling, methods, standards, costs and control functions of manufacturing. Laboratory problems covering producer and consumer products. Mr. Harder

IE 517 AUTOMATIC PROCESSES 3 (3-0) S
Prerequisites: IE 328, IE 443

Principles and methods for automatic processing. The design of product, process and controls. Economic, physical and sociological effects of automation. Mr. Harder

IE 521 CONTROL SYSTEMS AND DATA PROCESSING 3 (3-0) F
Prerequisite: IE 421

This course is designed to train the student in the problems and techniques required for systematic control of the production process and the business enterprise. This includes training in the determination of control factors, the collection and recording of data, and the processing, evaluation and use of data. The course will illustrate the applications and use of data processing equipment and information machines in industrial processes. Case problems will be used extensively. Graduate Staff

IE 522 (OR 522) DYNAMICS OF INDUSTRIAL SYSTEMS 3 (3-0) S
Prerequisite: IE 421

A study of the dynamic properties of industrial systems; introduction of servomechanism theory as applied to company operations. Simulation of large nonlinear, multiloop, stochastic systems on a digital computer; methods of determining modifications in systems design and/or operating parameters for improved system behavior. Mr. Llewellyn

IE 540 (PSY 540) HUMAN FACTORS IN SYSTEMS DESIGN 3 (3-0) F
(See psychology, page 422.) Mr. Soliday

IE 541 RESEARCH METHODS IN ACCIDENT STUDY 3 (2-2) F
Prerequisites: IE 441, ST 421

Consideration of the methods used in accident-injury study, including field investigation, experimental engineering and biomedical research, statistical studies, and computer simulation. (Offered in alternate years.) Mr. Pearson

IE 543 STANDARD DATA 3 (3-0) S
Prerequisite: IE 332

Theory and practice in developing standard data from stopwatch observations and predetermined time data; methods of calculating standards from data; application of standard data in cost control, production planning and scheduling, and wage incentives. Graduate Staff

IE 546 ADVANCED QUALITY CONTROL

3 (3-0) S

Prerequisites: IE 353, ST 421

The statistical foundations of quality control are emphasized in this course as well as its economic implications. Mathematical derivations of most of the formulae used are given. Sampling techniques are treated extensively and many applications of this powerful technique are explained.

Mr. Alvarez

IE 547 ENGINEERING RELIABILITY

3 (3-0) F

Prerequisites: ST 421, IE 353

The methodology of reliability including application of discrete and continuous distribution models and statistical designs; reliability estimation, reliability structure models, reliability demonstration and decisions, and reliability growth models. Examples of reliability evaluation and demonstration programs.

Graduate Staff

IE 591 PROJECT WORK

2-6 FS

Prerequisite: Graduate or senior standing

Investigation and report on an assigned problem for students enrolled in the fifth-year curriculum in industrial engineering.

Graduate Staff

FOR GRADUATES ONLY**IE 608 LINEAR PROGRAMMING APPLICATIONS**

3 (3-0) S

IE 609 (OR 609) ADVANCED DYNAMIC PROGRAMMING

3 (3-0) F

IE 611 THE DESIGN OF PRODUCTION SYSTEMS

3 (3-0) F

IE 621 (OR 621) INVENTORY CONTROL METHODS I

3 (3-0) FS

IE 622 INVENTORY CONTROL METHODS II

3 (3-0) F

IE 640 (PSY 640) SKILLED OPERATOR PERFORMANCE

3 (3-0) S

IE 641 BIOTECHNOLOGY IN SYSTEMS ENGINEERING

3 (3-0) F

IE 651 SPECIAL STUDIES IN INDUSTRIAL ENGINEERING

Credits Arranged

IE 692 (MA 692, OR 692) SPECIAL TOPICS IN MATHEMATICAL PROGRAMMING

3 (3-0) S

IE 693 SEMINAR IN SYSTEMS SAFETY ENGINEERING

1 (1-0) S

IE 694 ADVANCED PROBLEMS IN HUMAN FACTORS ENGINEERING

3 (3-0) S

IE 695 SEMINAR

1 (1-0) FS

IE 699 INDUSTRIAL ENGINEERING RESEARCH

Credits Arranged

INTERNATIONAL STUDENT ORIENTATION**ISO 100 AN INTRODUCTION TO THE UNITED STATES**

1 (1-0) FS

An orientation course required of all foreign students, new to the United States, which serves to acquaint them with the Raleigh Community, American culture,

University academic procedures, and U. S. Government regulations. Undergraduates should enroll for credit and graduates for audit. Mr. Weaver

LANDSCAPE ARCHITECTURE

LAR 201 FUNDAMENTALS OF LANDSCAPE DESIGN 3 (1-6) FS

Introductory exercises in landscape design. Site development and organization as related to climate, topography and prevalent social criteria. Staff

LAR 211 INTRODUCTION TO LANDSCAPE ARCHITECTURE 3 (3-0) FS

A survey course of the profession of landscape architecture for majors in the related fields of RRA, CE, FOR and HS, including the function, responsibilities and training of the landscape architect; the design process (criteria, approaches, sequence), office procedures and practices; formulation, presentation and interpretation of contract documents; and the relationship of landscape architecture to related fields. Staff

LAR 312 SITE PLANNING 3 (1-6) S

Prerequisite: Junior standing

The course is an introduction into the problems of small scale design and technical operations such as grading, alignment, controls will be covered. Staff

LAR 321, 322 LANDSCAPE MATERIALS I, II 3 (1-4) FS

Prerequisites: Science electives

A professional option for those students wishing to concentrate on small scale physical design. The course will cover identification and properties of materials. Exercises in design will stress implementation and use of materials for particular situations. Staff

LAR 400 INTERMEDIATE LANDSCAPE ARCHITECTURE DESIGN
(SERIES) 4 (1-9) FS

Prerequisite: DN 202 or equivalent or consent of department

The LAR 400 Series is intended to permit students a flexibility in scheduling. The courses will cover small scale design, urban landscape architecture, public and institutional design. Each course will be conducted as a workshop/studio to study the problems of project organization, design and execution. The course may be scheduled four times. Staff

LAR 411, 412 LANDSCAPE TECHNOLOGY 3 (1-6) FS

Prerequisite: Junior standing

Techniques and procedures of construction drawing. Contracts, specifications and office practices. Consolidation of previous technical course work by case study projects of various scales. Staff

LAR 491 SPECIAL PROJECTS IN LANDSCAPE ARCHITECTURE 2-4 FS

Prerequisites: Senior standing and 3.0 G.P.A.

The course is intended as a special projects framework for advanced undergraduates to do research on a tutorial basis. The course may be scheduled two times. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

LAR 501, 502 LANDSCAPE DESIGN I, II 6 (3-9) FS

Prerequisite: Graduate standing

Regional research and analysis. Social criteria of urban and regional design. Transportation systems, land use determination and the design of large scale environmental complexes. Open to graduate students in related fields. Evaluation of nonmajors based on contribution of their discipline to group effort.

LAR 503 REGIONAL DESIGN WORKSHOP I 3 (0-9) F
Prerequisite: Graduate standing

LAR 504 REGIONAL DESIGN WORKSHOP II 3 (0-9) S
Prerequisite: Graduate standing

LAR 512 PHYSICAL SYSTEMS 3 (2-2) S
Prerequisites: Graduate standing, consent of instructor

Analysis of physical systems and methods of determining relationships between systems with particular reference to natural systems, managed resource systems, development systems and their relationship to development objectives. Staff

LAR 521 INTRODUCTION TO REGIONAL DESIGN 3 (2-2) F
Prerequisite: Graduate standing

A perspective of the measures man has taken to ensure his relation to the general environment. Ecologic determinism, economic and political functionalism and aesthetic movements will be developed in an historical context. Staff

LAR 591, 592 SPECIAL PROJECTS 4 (2-6) FS
Prerequisite: Graduate standing

Student-evolved projects with emphasis on utilization and expansion of technical processes and techniques to reinforce design solutions. Introduction and investigation of experimental methodology. Development of student-evolved interest in specific areas. Open to graduate students in related fields. Evaluation of nonmajors based on contribution of their discipline to group effort.

FOR GRADUATES ONLY

LAR 603 REGIONAL DESIGN III 3 (0-9) F

LAR 604 REGIONAL DESIGN IV 3-6 S

LAR 611 PHYSICAL DESIGN POLICY 3 (2-2) FS

LAR 691 DEGREE SEMINAR 0

MARINE SCIENCES

FOR ADVANCED UNDERGRADUATES

MAS 200 (OY 200) INTRODUCTION TO THE MARINE ENVIRONMENT 3 (3-0)
Prerequisite: High school physics, chemistry, algebra, trigonometry and biology or equivalent

A descriptive account of the ocean as a part of our environment; subjects covered include interactions between atmosphere and ocean, ocean circulation, physical and chemical properties of sea water, marine geology and marine biology.

MAS 471 (MAE 471) UNDERSEA VEHICLE DESIGN 3 (3-0) F S
(See mechanical and aerospace engineering, page 376.)

MAS 487 (CE 487, OY 487)	PHYSICAL OCEANOGRAPHY	3 (3-0) S
(See physical oceanography, page 402.)		

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MAS 529 (ZO 529)	BIOLOGICAL OCEANOGRAPHY	3 (3-0) Sum.
(See zoology, page 460.)		

MAS 541 (OY 541, CE 541)	GRAVITY WAVE THEORY I	3 (3-0) S
Prerequisite: EM 303 or PY 411		

Classical gravity wave theory with emphasis on the basic mechanics of wave motions, mass transport induced by waves and various conservation laws with their applications in wave study.

MAS 551 (OY 551)	OCEAN CIRCULATION	3 (3-0) S
Prerequisite: EM 303 or PY 411		

Basic study of the mechanics of ocean circulation with emphasis on various simple models of circulation systems.

MAS 581 (CE 581)	INTRODUCTION TO OCEANOGRAPHIC ENGINEERING	3 (3-0) F
(See civil engineering, page 272.)		

MAS 584 (GY 584)	MARINE GEOLOGY	3 (3-0) S
(See geology, page 330.)		

MAS 591, 592	MARINE SCIENCES SEMINAR	1 (1-0) F S
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A seminar designed to give perspective in the field of oceanology. Topics vary from semester to semester. In order to obtain credit a student must deliver a seminar.

FOR GRADUATES ONLY

MAS 601 (OY 601)	ADVANCED PHYSICAL OCEANOGRAPHY I	3 (3-0) F
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MAS 602 (OY 602)	ADVANCED PHYSICAL OCEANOGRAPHY II	3 (3-0) S
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MAS 605 (OY 605, EM 605)	ADVANCED GEOPHYSICAL FLUID MECHANICS I	3 (3-0) F
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MAS 606 (OY 606, EM 606)	ADVANCED GEOPHYSICAL FLUID MECHANICS II	3 (3-0) S
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MAS 613 (OY 613, EM 613)	PERTURBATION METHOD IN FLUID MECHANICS I	3 (3-0) F
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MAS 614 (OY 614, EM 614)	PERTURBATION METHOD IN FLUID MECHANICS II	3 (3-0) S
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MATERIALS ENGINEERING

FOR UNDERGRADUATES

MAT 200 MECHANICAL PROPERTIES OF STRUCTURAL MATERIALS 2 (1-3)

Prerequisites: CH 105 and the first course in engineering mechanics

The dependence of mechanical properties of structural materials on macro-, micro- and crystalline structure; control of structure through treatment.

MAT 201 STRUCTURE AND PROPERTIES OF ENGINEERING MATERIALS I 3 (2-3)

Prerequisite: CH 105

An introduction to the fundamental physical principles governing the structure and constitution of metallic and nonmetallic materials of construction, and the relation of these principles to the control of properties.

MAT 218 INTRODUCTION TO CERAMIC ENGINEERING 4 (3-3) S

Prerequisite: CH 103 or CH 107

Calculation of material balances and stoichiometric relations in ceramic systems. Structure and properties of raw materials and process unit operations prior to forming are treated.

MAT 301 EQUILIBRIUM AND RATE PROCESSES IN MATERIALS SCIENCE 3 (3-0)

Prerequisite: CH 331 or equivalent

Application of thermodynamic and kinetic principles to engineering materials in the liquid and solid states.

MAT 310 PHYSICAL EXAMINATION OF MATERIALS 3 (1-6)

Prerequisite: MAT 201

Experiments designed to demonstrate basic techniques in crystallography. X-ray diffraction, optical and electron microscopy.

MAT 311 CERAMIC PROCESSING I 4 (3-3)

Prerequisite: MAT 201

A detailed study covering the basic chemical and physical laws underlying the processes and behavior of diverse ceramic compositions in the sequential manufacturing operations required to produce ceramic materials with controlled properties. Included are such topics as size reduction, separation and analysis; particle packing, mixing, agglomeration, surface chemistry, rheology of liquid-solid and solid-polymer systems; and behavior of ceramics in a wide variety of forming processes.

MAT 312 CERAMIC PROCESSING II 3 (3-0)

Prerequisite: MAT 311

Basic principles underlying the thermal processing of ceramics are covered. Appropriate subject material in basic and engineering sciences are included. Particular reference is made for obtaining desired microstructures. Included are such topics as fuels; combustion and heat sources; heat transfer and heat utilization; gas and liquid flow relation; psychrometry and drying; high temperature processing such as calcining, sintering in the presence and absence of liquid phases, melting and hot forming; and supplementary finishing processes after firing of the ceramic.

- MAT 411, 412 PHYSICAL PRINCIPLES IN MATERIALS SCIENCE I, II** 3 (3-0)
Prerequisites: (411) MAT 201; (412) MAT 411
 Introduction to the fundamental physical concepts of ceramic, metallic and polymeric materials. Relation between properties and structure.
- MAT 417 CERAMIC SUBSYSTEM DESIGN** 3 (2-3)
Prerequisite: MAT 312
 Individual and team study involving the interdependence of plant layout, processes, equipment and materials in the economic design of engineering systems and subsystems. Discussion of design principles, sources of data, creativity and economic analysis to encourage original solutions to problems of current and future need and interest in the ceramic profession.
- MAT 423, 424 MATERIALS FACTORS IN DESIGN I, II** (423) 3 (3-0)
 (424) 4 (3-3)
Prerequisites: (423) MAT 450; (424) MAT 423
Corequisites: (423) MAT 431; (424) MAT 432
 Selection of materials for specific engineering applications. Manufacturing processes and their relation to product use.
- MAT 431, 432 PHYSICAL METALLURGY I, II** 3 (3-0)
Prerequisites: (431) MAT 412; (432) MAT 431
 Alloy design; control of properties through microstructures; principles of heat treatment; strengthening mechanisms.
- MAT 435, 436 PHYSICAL CERAMICS I, II** (435) 4 (3-3)
 (436) 3 (2-3)
Prerequisites: (435) MAT 412; (436) MAT 435
 A project-oriented course in which starting materials of various types of ceramic products are characterized including analysis of reactions, selection of processing parameters, processing, measurement of properties appropriate to the ceramic analysis; and correlation of all materials and processing parameters with properties and microstructures. Projects are selected to exemplify characteristic types of ceramics.
- MAT 437 INTRODUCTION TO THE VITREOUS STATE** 3 (3-0)
Prerequisite: MAT 301
 An introductory study of the vitreous state to include the structure, properties and type of glasses (including glazes and enamels). Opacity color and devitrification. Nature of the glassy phase in kiln-fired ceramics.
- MAT 450 MECHANICAL PROPERTIES OF MATERIALS** 3 (2-3)
Prerequisite: MAT 201
 Elastic, plastic, and fracture phenomena in solids including yielding, strain hardening, brittle fracture, creep and fatigue.
- MAT 451 PRINCIPLES OF CERAMIC ENGINEERING** 3 (3-0) F
Prerequisite: CH 433 or MAE 302 or CHE 315
 An advanced treatment of fundamental relationships among ceramic materials, processes and properties. Designed to provide an adequate background for students from other engineering and physical science curricula to permit effective study of ceramic engineering at the graduate level.
- MAT 491 MATERIALS ENGINEERING SEMINAR** 1 (1-0)
Prerequisite: Senior standing
 Literature survey of selected topics in materials engineering. Oral and written reports and discussions.

MAT 493, 494 CERAMIC FIELD EXERCISES I, II 1 (0-3)
Prerequisite: Senior standing
 Selected plant visitations, lectures by practicing ceramic engineers, reports on industrial organizations engaged in manufacture or use of ceramics. Discussions of professional organizations and professional ethics.

MAT 495, 496 EXPERIMENTAL ENGINEERING I, II 3 (1-6)
Prerequisite: Senior standing
 Advanced engineering principles applied to a specific project dealing with metallurgy, materials or general experimental work. A seminar period is provided and a written report required.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MAT 501, 502 CERAMIC STRUCTURAL ANALYSIS I, II 3 (3-0) FS
Prerequisite: MAT 411

MAT 503 CERAMIC MICROSCOPY 3 (2-3) FS
Prerequisite: GY 331

Transmitted and reflected light techniques for the systematic study of ceramic materials and products.

MAT 506 ELECTRON MICROSCOPY 3 (2-3)
Prerequisite: MAT 412

MAT 509 HIGH VACUUM TECHNOLOGY 3 (2-3)
Prerequisite: CH 433 or MAE 301

Properties of low-pressure gases and vapors. Production, maintenance and measurement of high vacuum; design, construction and operation of high-vacuum, high-temperature facilities. Properties and reactions of materials which are processed, tested and/or utilized in high-vacuum environments.

MAT 521, 522 ADVANCED PHYSICAL METALLURGY I, II 3 (3-0) FS
Prerequisite: MAT 432

MAT 527 REFRACTORIES IN SERVICE 3 (3-0) FS
Prerequisite: MAT 411

A study of the physical and chemical properties of the more important refractories in respect to their environment in industrial and laboratory furnaces.

MAT 529 PROPERTIES OF HIGH TEMPERATURE MATERIALS 3 (3-0)
Prerequisite: MAT 201

Effect of temperature on the physical, mechanical and chemical properties of inorganic materials; relationships between microstructure and high temperature properties; uses of ceramics, cermets and metals at extremely high temperatures.

MAT 533, 534 ADVANCED CERAMIC ENGINEERING DESIGN I, II 3 (2-3)
Prerequisite: MAT 417

Advanced studies in analysis and design of ceramic products, processes and systems leading to original solutions of current industrial problems and the development of new concepts of manufacturing.

MAT 540 GLASS TECHNOLOGY 3 (3-0) FS
Prerequisite: MAT 437

MAT 541, 542 PRINCIPLES OF CORROSION I, II 3 (2-3) FS
Prerequisite: MAT 431 or CH 431

The fundamentals of metallic corrosion and passivity. The electrochemical nature of corrosive attack, basic forms of corrosion, corrosion rate factors, methods of corrosion protection. Laboratory work included.

MAT 548 TECHNOLOGY OF CEMENTS 3 (3-0) S
Prerequisite: MAT 436

The technology of the Portland cement industry including manufacture, control and uses.

MAT 561 ADVANCED STRUCTURE AND PROPERTIES OF MATERIALS 3 (2-3) F
Prerequisite: MAT 411

A systematic treatment of the fundamental physicochemical principles governing the constitution of both metallic and ceramic materials. Correlation of these principles with physical, mechanical and chemical properties of materials. Particular emphasis is placed upon materials of construction for nuclear reactors.

MAT 562 (NE 562) MATERIALS PROBLEMS IN NUCLEAR ENGINEERING 3 (3-0)
Prerequisite: NE 301 or equivalent

Those reactor component design considerations determined by materials properties as well as by nuclear function will be discussed. Emphasis will be placed on radiation metallurgical processes in materials pertinent to fast reactors for either terrestrial or space applications.

MAT 573 (NE 573) COMPUTER EXPERIMENT IN MATERIALS ENGINEERING 3 (3-0) F
Prerequisites: PY 407, MA 301

The basic techniques for constructing both statistical (Monte Carlo) and deterministic computer experiments will be explained and discussed from the standpoint of immediate use in the solution of current engineering research and development problems. Mr. Beeler

MAT 595, 596 ADVANCED MATERIALS EXPERIMENTS I, II 3 (1-6) FS
Prerequisite: MAT 411

Advanced engineering principles applied to a specific experimental project dealing with materials or metallography. A seminar period is provided and a written report is required.

MAT 598, 599 ADVANCED CERAMIC EXPERIMENTS I, II 3 (1-6) FS
Prerequisite: MAT 411

Advanced studies in ceramic laboratory experimentation.

FOR GRADUATES ONLY

MAT 601 CERAMIC PHASE RELATIONSHIPS 3 (3-0) FS

MAT 603 ADVANCED CERAMIC REACTION KINETICS 3 (3-0) S

MAT 611 CERAMIC PROCESS ANALYSIS 3 (3-0) FS

MAT 621 THE VITREOUS STATE 3 (3-0) FS

MAT 631, 632 ADVANCED PHYSICAL CERAMICS I, II 3 (2-3)

MAT 635, 636 ELECTRONIC CERAMICS 3 (3-0)

MAT 651, 652	THEORY AND STRUCTURE OF METALS	3 (3-0) FS
MAT 661	DIFFRACTION THEORY	3 (3-0) FS
MAT 662	DISLOCATION THEORY	3 (3-0) FS
MAT 691, 692	SPECIAL TOPICS IN MATERIALS ENGINEERING	3 (3-0)
MAT 695	CERAMIC ENGINEERING SEMINAR	1 (1-0) FS
MAT 697	SPECIAL STUDIES IN CERAMIC ENGINEERING	1-3
MAT 699	RESEARCH	Credits Arranged

MATHEMATICS

MA 111	ALGEBRA AND TRIGONOMETRY	4 (3-2) F S
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Sets and logic, the real number system, polynomials, algebraic fractions, exponents and radicals, linear and quadratic equations, inequalities, functions and relations, logarithms, plane trigonometry. (Students in the Schools of Engineering, PAMS, Design and Departments of Agricultural Engineering and Mathematics Education who may be required to take this course will not receive credit hours for MA 111 toward the graduation requirements.)

MA 102	ANALYTIC GEOMETRY AND CALCULUS I	4 (3-2) F S
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Prerequisite: MA 111 or equivalent completed in high school

The first of three semesters of a unified course in analytic geometry and calculus. Functions and graphs, limits, derivatives of algebraic functions and applications, indefinite integral, definite integral and the fundamental theorem of calculus, areas and volumes, plane analytic geometry.

Credit in both MA 102 and MA 112 is not allowed.

MA 112	ANALYTIC GEOMETRY AND CALCULUS A	4 (3-2) F S
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Prerequisite: MA 111 or equivalent completed in high school

A unified course in analytic geometry and calculus containing the following topics: the straight line; nonlinear equations and graphs; functions and limits; the derivative and its applications, antidifferentiation and integration. Applications to the social, life and behavioral sciences are included where possible.

Credit in both MA 102 and MA 112 is not allowed.

MA 114	TOPICS IN MODERN MATHEMATICS	3 (3-0) F S
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Prerequisite: MA 111 or equivalent completed in high school

Introduction to the theory of sets, relations and functions with applications to Boolean algebra, logical inference, theory of probability, vector spaces and matrices.

MA 115	INTRODUCTION TO CONTEMPORARY MATHEMATICS I	3 (3-0) F
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Prerequisite: College entrance

The number system and other scales of notation; algebraic operations, inequalities; sets, logic and Boolean algebra; logarithmic and trigonometric functions. The point of view is intuitive. Some emphasis is placed on the history of certain mathematical concepts and on the importance of mathematics in contemporary life.

Credit in MA 115 is not allowed if the student already has credit in MA 201 or MA 212.

MA 116 INTRODUCTION TO CONTEMPORARY MATHEMATICS II 3 (3-0) S
Prerequisite: MA 115

Permutations, combinations and the binomial theorem; probability; mathematical induction, the group as an example of a finite mathematical system; graphs of systems of linear inequalities and linear programming; solutions of linear systems by Cramer's rule and by matrix methods; introduction to analytic geometry and calculus.

Credit in MA 116 is not allowed if student already has credit in MA 201 or MA 212.

MA 122 MATHEMATICS OF FINANCE AND ELEMENTARY STATISTICS 4 (3-2) F S
Prerequisite: MA 111

Simple and compound interest, annuities and their application to amortization and sinking fund problems, installment buying, calculation of premiums of life annuities and life insurance, elementary statistics.

MA 201 ANALYTIC GEOMETRY AND CALCULUS II 4 (4-0) F S
Prerequisite: MA 102

The second of three semesters of a unified course in analytic geometry and calculus. Applications of the definite integral. Transcendental functions, methods of integration, polar coordinates, parametric equations, introduction to infinite series.

MA 202 ANALYTIC GEOMETRY AND CALCULUS III 4 (4-0) F S
Prerequisite: MA 201

The third of three semesters of a unified course in analytic geometry and calculus. Brief introduction to determinants and matrices, vector functions, analytic geometry of three dimensions and partial differentiation, multiple integration, applications. Line integral and Green's Theorem.

MA 212 ANALYTIC GEOMETRY AND CALCULUS B 3 (3-0) F S
Prerequisite: MA 112

A continuation of MA 112. Differentiation and integration of trigonometric exponential and logarithmic functions, methods of integration, application of the integral; functions of several variables, infinite series. Applications to social, life and behavioral sciences are included where possible.

MA 231 INTRODUCTION TO LINEAR ALGEBRA 3 (3-0) F S
Prerequisite: MA 201

Vectors and vector spaces, linear transformations, linear equations, determinants, eigenvalues and quadratic forms.

MA 232 INTRODUCTION TO MULTIVARIABLE CALCULUS 3 (3-0) F S
Prerequisite: MA 231

Functions of several variables, limits, continuity, differentiability, chain rule, implicit functions, multiple integrals.

MA 301 APPLIED DIFFERENTIAL EQUATIONS I 3 (3-0) F S
Prerequisite: MA 202 or equivalent

First order equations, applications, linear equations of higher order, applications to mechanical and electrical systems, series solutions, special functions, Laplace transforms.

MA 312 INTRODUCTION TO DIFFERENTIAL EQUATIONS 3 (3-0) F S
Prerequisites: MA 231, MA 201

First order differential equations, basic theory and application of linear equations. Systems of linear equations, matrix methods, series solutions, Laplace transforms, existence and uniqueness.

MA 381 SPECIAL TOPICS 1-6 F S
 Prerequisite: Consent of department
 This course will be used to develop unusual or new mathematics courses for the needs of students in any curriculum.

FOR ADVANCED UNDERGRADUATES

MA 401 APPLIED DIFFERENTIAL EQUATIONS II 3 (3-0) F S
 Prerequisite: MA 301

The wave, heat and Laplace equations. Solutions by separation of variables and expansion in Fourier Series or other appropriate orthogonal sets.

MA 403 INTRODUCTION TO MODERN ALGEBRA 3 (3-0) F S
 Prerequisite: One year of calculus

Sets and mappings; equivalence relations; groups, homomorphisms, cosets, Cayley's theorem, symmetric groups, quotient groups, rings, integral domains; Euclidean algorithm, polynomial rings, ideals, quotient rings.

MA 404 FUNDAMENTAL CONCEPTS OF GEOMETRY 3 (3-0) S
 Prerequisite: One year of calculus

Foundations of geometry; laws of logic; affine geometry, geometric transformations, homogeneous coordinates; comparison of Euclidean and non-Euclidean geometries.

MA 405 INTRODUCTION TO MATRICES AND LINEAR TRANSFORMATIONS 3 (3-0) F S
 Prerequisite: One year of calculus

Determinants, linear equations, linear transformations and matrices, operations with matrices, eigenvalues, introduction to bilinear and quadratic forms.

MA 408 ADVANCED GEOMETRY 3 (3-0) F
 Prerequisite: One year of calculus

Topics from modern geometry; poles and polars; non-Euclidean geometry; analytical geometry from a vector point of view; elementary geometry from an advanced standpoint.

MA 421 INTRODUCTION TO PROBABILITY 3 (3-0) F S
 Prerequisite: One year of calculus

Axioms of probability, conditional probability, combinatorial analysis, random variables, expectation, simple stochastic processes.

MA 425 MATHEMATICAL ANALYSIS I 3 (3-0) F
 Prerequisite: MA 232

Real number system, functions and limits, topology on the real line, continuity, differential and integral calculus for functions of one variable.

MA 426 MATHEMATICAL ANALYSIS II 3 (3-0) S
 Prerequisite: MA 425

Infinite series, uniform convergence, calculus of several variables, topology in n-dimensions, limits, continuity, differentiability, implicit functions, multiple integrals, line and surface integrals.

MA 433 HISTORY OF MATHEMATICS 3 (3-0) S
 Prerequisite: One year of calculus

Evolution of the number system, trends in the development of modern mathematics; lives and contributions of outstanding mathematicians.

MA 491 READING IN HONORS MATHEMATICS	2-6 F S
Prerequisites: Membership in honors program, consent of department	
MA 493 SPECIAL TOPICS IN MATHEMATICS	1-6 F S
Prerequisite: Consent of department	

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MA 504 (NE 504) MATHEMATICAL METHODS IN ENGINEERING	3 (3-0) F
Prerequisite: MA 301	

Survey of mathematical methods for engineers. Topics include ordinary differential equations, matrices, partial differential equations, difference equations, numerical methods, elements of statistics. Techniques and applications to engineering are stressed. This course cannot be taken for credit by mathematics majors.

MA 505 (IE 505, OR 505) MATHEMATICAL PROGRAMMING I	3 (3-0) F
(See industrial engineering, page 353.)	

MA 511 ADVANCED CALCULUS I	3 (3-0) F S
Prerequisite: MA 301	

Fundamental theorem on continuous functions; convergence theory of sequences, series and integrals; the Riemann integral.

MA 512 ADVANCED CALCULUS II	3 (3-0) F S
Prerequisite: MA 511	

General theorems of partial differentiation; implicit function theorems; vector calculus in 3-space; line and surface integrals; classical integral theorems.

MA 513 INTRODUCTION TO COMPLEX VARIABLES	3 (3-0) F S
Prerequisite: MA 511 or MA 426	

Operations with complex numbers, derivatives, analytic functions, integrals, definitions and properties of elementary functions, multivalued functions, power series, residue theory and applications, conformal mapping.

MA 514 METHODS OF APPLIED MATHEMATICS	3 (3-0) S
Prerequisite: MA 511 or MA 425	

Introduction to integral equations, the calculus of variations and difference equations.

MA 517 INTRODUCTION TO TOPOLOGY	3 (3-0) F S
Prerequisite: MA 426	

Sets and functions, metric spaces, topological spaces, compactness, separation, connectedness.

MA 518 CALCULUS ON MANIFOLDS	3 (3-0) S
Prerequisite: MA 517	

Calculus of several variables from a modern viewpoint. Differential and integral calculus of several variables, vector functions, integration on manifolds, Stoke's and Green's theorems, vector analysis.

MA 520 LINEAR ALGEBRA	3 (3-0) F S
Prerequisite: MA 231 or MA 405	

Vector spaces, linear mappings and matrices, determinants, inner product spaces, bilinear and quadratic forms, canonical forms, spectral theorem.

MA 521 FUNDAMENTALS OF MODERN ALGEBRA**3 (3-0) F S****Prerequisite:** MA 403

Groups, normal subgroups, quotient groups, Cayley's theorem, Sylow's theorem. Rings, ideals and quotient rings, polynomial rings. Fields, extension fields, elements of Galois theory.

MA 524 MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES I**3 (3-0) F****Prerequisites:** MA 405, MA 512

Green's functions and two point boundary value problems; elementary theory of distributions; generalized Green's functions. Finite and infinite dimensional inner product spaces; Hilbert spaces; completely continuous operators; integral equations, the Fredholm alternative; eigenfunction expansions; applications to potential theory. Nonsingular and singular Sturm-Liouville problems; Weil's theorem.

MA 525 MATHEMATICAL METHODS IN THE PHYSICAL SCIENCES II**3 (3-0) S****Prerequisite:** MA 524

Distribution theory in n -space; Fourier transforms; partial differential equations, generalized solutions, fundamental solutions, Cauchy problem, wave and heat equations, well-set problems, Laplace's equation, the Dirichlet and Neumann problems, integral equations of potential theory, Green's functions, eigenfunction expansions.

MA 527 (CSC 527) NUMERICAL ANALYSIS I**3 (3-0) F S****Prerequisites:** CSC 101 or CSC 111, MA 301 or MA 312, MA 231 or MA 405

Theory of interpolation, numerical integration, iterative solution of nonlinear equations, numerical integration of ordinary differential equations, matrix inversion and solution of simultaneous linear equations.

MA 528 (CSC 528) NUMERICAL ANALYSIS II**3 (3-0) S****Prerequisite:** MA 527

Least squares data approximation, expansions in terms of orthogonal functions, Gaussian quadrature, economization of series, minimax approximations, Padé approximations, eigenvalues of matrices.

MA 532 THEORY OF ORDINARY DIFFERENTIAL EQUATIONS**3 (3-0) S****Prerequisites:** MA 301, MA 405, advanced calculus

Existence and uniqueness theorems, systems of linear equations, fundamental matrices, matrix exponential, series solutions, regular singular points; plane autonomous systems, stability theory.

MA 536 LOGIC FOR DIGITAL COMPUTERS**3 (3-0) F****Prerequisite:** MA 405

Introduction to symbolic logic and Boolean algebra, finite state-valued calculus and its application to combinational networks; sequential finite-state machines and their mathematical formulation; analysis and synthesis problems of sequential machines.

MA 537 MATHEMATICAL THEORY OF DIGITAL COMPUTERS**3 (3-0) S****Prerequisite:** MA 536

The sequential machine and its characteristic semi-group; micro-programmed computers; general purpose computers and special purpose computers; Turing machine and infinite-state machines; nondeterministic switching system and probabilistic automata.

MA 541 (ST 541) THEORY OF PROBABILITY I**3 (3-0) F****Prerequisite:** MA 425 or MA 511

Axioms, combinatorial analysis, conditional probability, independence, random variables, expectation, special discrete and continuous distributions, probability and

moment generating functions, central limit theorem, laws of large numbers, branching processes, recurrent events, random walk.

MA 542 (ST 542) THEORY OF PROBABILITY II 3 (3-0) S
Prerequisites: MA 405, MA 541

Markov chains and Markov processes, Poisson process, birth and death processes, queueing theory, renewal theory, stationary processes, Brownian motion.

MA 545 SET THEORY AND FOUNDATIONS OF MATHEMATICS 3 (3-0) S
Prerequisite: MA 403

Logic and the axiomatic approach, the Sermelo-Fraenkel axioms and other systems, algebra of sets and order relations, equivalents of the Axiom of Choice, one-to-one correspondences, cardinal and ordinal numbers, the Continuum Hypothesis.

MA 555 (PY 555) MATHEMATICAL INTRODUCTION TO CELESTIAL MECHANICS 3 (3-0) F
Prerequisite: One year of advanced calculus

Central orbits, N-body problems, 3-body problem, Hamilton-Jacobi theory, Perturbation theory, applications to motion of celestial bodies.

MA 556 (PY 556) ORBITAL MECHANICS 3 (3-0) F
Prerequisites: MA 301, MA 405, knowledge of elementary mechanics and computer programming

Keplerian motion, iterative solutions, numerical integration, differential corrections and space navigation, elements of probability, least squares, sequential estimation, Kalman fields.

MA 571 (BMA 571, ST 571) BIOMATHEMATICS I 3 (3-0) F
(See biomathematics, page 253.)

MA 572 (BMA 572, ST 572) BIOMATHEMATICS II 3 (3-0) S
(See biomathematics, page 253.)

MA 581 SPECIAL TOPICS 1-6 F S
Prerequisite: Consent of department

FOR GRADUATES ONLY

MA 600 ADVANCED DIFFERENTIAL EQUATIONS I 3 (3-0) F

MA 601 ADVANCED DIFFERENTIAL EQUATIONS II 3 (3-0) S

MA 602 PARTIAL DIFFERENTIAL EQUATIONS I 3 (3-0) F

MA 603 PARTIAL DIFFERENTIAL EQUATIONS II 3 (3-0) S

MA 606 (ST 606, OR 606) MATHEMATICAL PROGRAMMING II 3 (3-0) F S

MA 611 ANALYTIC FUNCTION THEORY I 3 (3-0) F S

MA 612 ANALYTIC FUNCTION THEORY II 3 (3-0) F S

MA 615 THEORY OF FUNCTIONS OF A REAL VARIABLE I 3 (3-0) F

MA 616 THEORY OF FUNCTIONS OF A REAL VARIABLE II 3 (3-0) S

MA 617 (ST 617)	MEASURE THEORY AND ADVANCED PROBABILITY	3 (3-0) F
MA 618 (ST 618)	MEASURE THEORY AND ADVANCED PROBABILITY	3 (3-0) S
MA 619 (ST 619)	TOPICS IN ADVANCED PROBABILITY	3 (3-0) F
MA 620	MODERN ALGEBRA I	3 (3-0) F
MA 621	MODERN ALGEBRA II	3 (3-0) S
MA 622	LINEAR TRANSFORMATIONS AND MATRIX THEORY	3 (3-0) F
MA 623	THEORY OF MATRICES AND APPLICATIONS	3 (3-0) S
MA 625	ALGEBRAIC TOPOLOGY I	3 (3-0) F
MA 626	ALGEBRAIC TOPOLOGY II	3 (3-0) S
MA 627	GENERAL TOPOLOGY I	3 (3-0) F
MA 628	GENERAL TOPOLOGY II	3 (3-0) S
MA 632	OPERATIONAL MATHEMATICS I	3 (3-0) F
MA 633	OPERATIONAL MATHEMATICS II	3 (3-0) S
MA 634	THEORY OF DISTRIBUTIONS	3 (3-0) F
MA 635	NUMERICAL ANALYSIS III	3 (3-0) S
MA 637	DIFFERENTIABLE MANIFOLDS	3 (3-0) F
MA 641	CALCULUS OF VARIATIONS AND THEORY OF OPTIMAL CONTROL I	3 (3-0) F
MA 642	CALCULUS OF VARIATIONS AND THEORY OF OPTIMAL CONTROL II	3 (3-0) S
MA 645	THEORY OF HILBERT SPACES	3 (3-0) S
MA 647	FUNCTIONAL ANALYSIS I	3 (3-0) F
MA 648	FUNCTIONAL ANALYSIS II	3 (3-0) S
MA 655 (PY 655)	QUALITATIVE METHODS IN CELESTIAL MECHANICS	3 (3-0) F
MA 656 (PY 656)	PERTURBATION THEORY IN CELESTIAL MECHANICS	3 (3-0) S
MA 661	DIFFERENTIAL GEOMETRY AND TENSOR ANALYSIS I	3 (3-0) F
MA 662	DIFFERENTIAL GEOMETRY AND TENSOR ANALYSIS II	3 (3-0) S
MA 681	SPECIAL TOPICS IN REAL ANALYSIS	1-6
MA 682	SPECIAL TOPICS IN COMPLEX ANALYSIS	1-6
MA 683	SPECIAL TOPICS IN ALGEBRA	1-6
MA 684	SPECIAL TOPICS IN COMBINATORIAL ANALYSIS	1-6
MA 685	SPECIAL TOPICS IN NUMERICAL ANALYSIS	1-6

MA 686	SPECIAL TOPICS IN TOPOLOGY	1-6
MA 687	SPECIAL TOPICS IN GEOMETRY	1-6
MA 688	SPECIAL TOPICS IN DIFFERENTIAL EQUATIONS	1-6
MA 689	SPECIAL TOPICS IN APPLIED MATHEMATICS	1-6
MA 692 (IE 692, OR 692)	SPECIAL TOPICS IN MATHEMATICAL PROGRAMMING	3 (3-0) S
MA 699	RESEARCH	Credits Arranged

MATHEMATICS AND SCIENCE EDUCATION

FOR UNDERGRADUATES

ED 101	ORIENTATION	0 (1-0) F
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New freshmen and transfer students are required to attend one hour per week during the fall semester. Activities center around helping the student to establish good study habits and to adjust to university life.

Staff

ED 203	INTRODUCTION TO TEACHING MATHEMATICS AND SCIENCE	2 (2-0) F S
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A beginning course designed for prospective teachers of mathematics and science at the secondary school level. Emphasis is given to study of different modes of instruction and instructional strategies. Each prospective teacher is expected to design a lesson and teach it to students in the school to which he is assigned as a teacher assistant.

Staff

ED 470	METHODS OF TEACHING MATHEMATICS	3 (3-0) F S
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A study of the purposes, methods, materials, curricula and evaluation practices appropriate for teachers of mathematics at the secondary level.

Messrs. Kolb, Speece, Waters, Watson

ED 471	STUDENT TEACHING IN MATHEMATICS	6 (2-15) F S
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Prerequisites: ED 344, PSY 304, senior standing, admission to teacher education and an overall 2.0 average.

This course is intended to provide the prospective teacher with an opportunity to get experience in the skills and the techniques involved in teaching mathematics. Each student during the senior year will spend 10 weeks off campus in a selected center. In addition to acquiring the necessary competencies for teaching mathematics, the student teachers also will have an opportunity to become familiar with the total school program and to participate in as many community activities as time will permit during the period of student teaching.

Messrs. Kolb, Speece, Waters, Watson

ED 472	DEVELOPING AND SELECTING TEACHING MATERIALS IN MATHEMATICS	2 (2-0) F S
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Developing and selecting teaching materials in keeping with the new and changing concepts of the content and emphasis in high school mathematics is essential for mathematics teachers. The course will follow the class discussion and demonstration pattern. Students will study the latest instructional materials and discover or devise materials and aids for increasing the effectiveness of the content and instruction in high school mathematics.

Messrs. Kolb, Speece, Waters, Watson

ED 475 METHODS OF TEACHING SCIENCE**3 (3-0) F**

A study of the purposes, methods, materials, curricula and evaluation practices appropriate for teachers of physical and natural science at the secondary level.
Messrs. Anderson, Shannon

ED 476 STUDENT TEACHING IN SCIENCE**6 (2-15) F**

Prerequisites: ED 344, PSY 304, senior standing, admission to teacher education and an overall 2.0 average

This course is intended to provide prospective teachers with an opportunity to get experience in the skills and techniques involved in teaching science. Each student during the senior year will spend 10 weeks off campus in a selected center. In addition to acquiring the necessary competencies for teaching science, the student teacher also will have an opportunity to become familiar with the total program and to participate in as many community activities as time will permit during the period of student teaching.
Messrs. Anderson, Shannon, Speece

ED 477 DEVELOPING AND SELECTING TEACHING MATERIALS IN SCIENCE**2 (2-0) F**

Developing and selecting teaching materials in keeping with the new and changing concepts of the content and emphasis in high school science, particularly the experimental and laboratory approach to science teaching. Students will study the latest instructional materials and discover or devise materials and aids for increasing the effectiveness of the content and instruction in high school science courses.
Messrs. Anderson, Shannon

FOR GRADUATES AND ADVANCED UNDERGRADUATES**ED 511 IMPLICATIONS OF MATHEMATICAL CONTENT, STRUCTURE, AND PROCESSES FOR THE TEACHING OF MATHEMATICS IN THE ELEMENTARY SCHOOL****3 (3-0) F**

Prerequisite: Bachelor's degree in elementary education or consent of instructor

A course designed for teachers and supervisors of mathematics in the elementary school. Special emphasis is given to the implications of mathematical content, structure and processes in teaching arithmetic and geometry in the elementary school. Attention is given to the use of logic and fundamental rules of inference, deductive and inductive reasoning, the field properties in the sets of integers and rational numbers, elementary number theory, metric and nonmetric geometry. Mr. Watson

ED 512 ACTIVE LEARNING APPROACHES TO TEACHING MATHEMATICS IN THE ELEMENTARY SCHOOL**3 (3-0) S**

Prerequisite: Bachelor's degree in elementary education or consent of instructor

A course that will stress active learning approaches to the teaching of mathematics in the elementary school. Special emphasis will be given to the laboratory approach to teaching mathematics and the use of the manipulative materials and activities of the Nuffield Project, the Madison Project, Dienes, Cuisenaire and Gattegno. Attention will be given to research supporting the laboratory approach using manipulative materials in the elementary school. Suggestions will be given for designing activities for independent and group study and in assessing individual progress.
Mr. Watson

ED 592 SPECIAL PROBLEMS IN MATHEMATICS TEACHING**3 (0-3) S**

Prerequisite: ED 471 or equivalent

Consideration of current problems in mathematics education. Opportunities will be provided for students to study particular problems and initiate investigations under the direction of the faculty.
Mr. Speece

ED 594 SPECIAL PROBLEMS IN SCIENCE TEACHING**3 (0-3) S****Prerequisite:** ED 476 or equivalent

Consideration of current problems in science education. Opportunities will be provided for students to study particular problems and initiate investigations under the direction of the faculty.

Mr. Anderson**FOR GRADUATES ONLY****ED 690 SEMINAR IN MATHEMATICS EDUCATION****Maximum 2 F S****ED 695 SEMINAR IN SCIENCE EDUCATION****Maximum 2 F S****ED 699 RESEARCH****Credits Arranged****MECHANICAL AND AEROSPACE ENGINEERING****FOR UNDERGRADUATES****MAE 216 ELEMENTS OF MECHANICAL ENGINEERING****3 (3-0) S****Prerequisites:** EM 205, PY 208 or PY 206

An introductory consideration of the scope and interests in mechanical engineering through the application and extension of chemistry, physics and mathematics to real engineering problems in analysis and design.

MAE 250 INTRODUCTION TO AEROSPACE ENGINEERING**3 (3-0) S****Prerequisite:** PY 205

Fundamental concepts underlying aerospace engineering. A basic study of the aerodynamics, structural, propulsion, performance and control requirements of flight vehicles.

MAE 301 ENGINEERING THERMODYNAMICS I**3 (3-0) F S****Prerequisites:** MA 202, PY 208 or PY 206

An introduction to the concept of energy and the laws governing the transfers and transformations of energy. Emphasis is placed on thermodynamic properties and First and Second law analysis of systems. Some basic statistical thermodynamic concepts are introduced and applied to the calculation of properties.

MAE 302 ENGINEERING THERMODYNAMICS II**3 (3-0) S****Prerequisite:** MAE 301

A continuation of Engineering Thermodynamics I with emphasis on the application of basic principles to engineering problems with systems involving mixtures of ideal gases, psychrometrics, nonideal gases, chemical reactions, combustion, chemical equilibrium, cycle analysis and one-dimensional compressible flow.

MAE 303 ENGINEERING THERMODYNAMICS III**3 (3-0) S****Prerequisite:** MAE 301

A continuation of Engineering Thermodynamics I for nonmechanical engineering juniors. Thermodynamics of mixtures; thermodynamics of fluid flow, heat transfer, vapor and gas cycles, and applications.

MAE 305 MECHANICAL ENGINEERING LABORATORY I**1 (0-3) F****Corequisite:** MAE 301

An introduction to the theory and practice of measurement and experimental

data collection. The components of the generalized measurement system are studied and their effects on the final result evaluated. Basic methods of data analysis as well as basic instrumentation for sensing, conditioning and displaying experimental quantities are covered.

MAE 306 MECHANICAL ENGINEERING LABORATORY II 1 (0-3) S
Prerequisites: MAE 305, EE 331

A continuation of MAE 305 into specific types of measurements. Students will evaluate and compare different types of instrumentation for measuring the same physical quantity on the basis of cost, time required, accuracy, etc.

MAE 307 ENERGY AND ENERGY TRANSFORMATIONS 3 (3-0) F
Prerequisites: MA 201, PY 212

Energy transformation as permitted by the First Law and limited by the Second Law. Properties of ideal gases and actual gases; properties of vapors. Vapor power cycles; vapor refrigerating cycles, gas cycles for internal combustion engines and gas turbines. Elements of heat transfer.

MAE 313 POWER TRANSMISSION 3 (3-0) S
Prerequisite: MAE 307

Analysis and synthesis of the operational characteristics of machines and systems comprising mechanical hydraulic and control devices. Comparative characteristics of such devices with regard to choice of system combinations based on performance, maintenance and economics.

MAE 315 DYNAMICS OF MACHINES 3 (3-0) F
Prerequisites: MAE 216, EM 305

A rational application of dynamics to the analysis of machines and mechanical devices to determine the motions resulting from applied loads and the forces and inputs required to produce specified motions.

MAE 316 STRENGTH OF MECHANICAL COMPONENTS 3 (3-0) S
Prerequisites: EM 205, MAT 201

Stress, strain and deformation analysis of mechanical components and their strength determination based on material behavior under static and dynamic operating conditions. Applications to basic machine components.

MAE 355 AERODYNAMICS I 4 (3-3) F
Prerequisites: MAE 250, MA 301

Introductory concepts of perfect fluid theory and incompressible boundary layers with application to the computation of the aerodynamic characteristics of airfoils, wings and flight vehicle configurations.

MAE 356 AERODYNAMICS II 4 (3-3) S
Prerequisites: MAE 355, MAE 301

Introductory concepts of thermodynamics, compressible fluid flow and compressible boundary layers with application to the computation of the aerodynamic characteristics of airfoils, wings and flight vehicle configurations at high speed.

MAE 361 AEROSPACE VEHICLE PERFORMANCE 3 (3-0) F
Prerequisites: MAE 250, MA 301, EM 305

An application of the principles of dynamics and aerodynamics to the problem of determining the performance of both airplanes and space vehicles. Includes the elements of orbital mechanics and dynamics of boost into and reentry from orbit. For aircraft, methods are presented for the calculation of airplane performance in level, gliding and climbing flight as well as take-off and landing performance.

MAE 365 AIR-BREATHING PROPULSION SYSTEMS**4 (3-3) S****Prerequisites:** MAE 355, MAE 301

Introduction to one-dimensional internal flow of compressible fluids and to combustion and thermochemistry problems. Application of these processes to air-breathing aircraft propulsion systems. Performance analysis of components and complete propulsion systems.

MAE 371 AEROSPACE VEHICLE STRUCTURES I**3 (3-0) S****Prerequisites:** MAE 250, EM 205

Introduction to the theory and concepts required for the analysis and design of flight vehicle structural members. Properties and selection of materials; methods of analysis for axial, torsional, flexural and transverse shear loadings of typical flight structure members.

FOR ADVANCED UNDERGRADUATES**MAE 401 ENERGY CONVERSION****3 (3-0) F S****Prerequisite:** MAE 302

Applications of the principles of thermodynamics, fluid mechanics, heat transfer and combustion to power generation. Both the conventional and direct energy conversion methods are studied as to the principles involved and the feasibility and limitations of each method. Consideration is given to the economics of power generation.

MAE 402 HEAT AND MASS TRANSFER**3 (3-0) F S****Prerequisites:** MAE 302, MA 301

A study of the fundamental relationships of steady and transient heat transfer by conduction, convection, radiation and during changes of phase: mass transfer by diffusion and convection, simultaneous mass and heat transfer

MAE 403 AIR CONDITIONING**3 (3-0) F****Prerequisite:** MAE 302

A fundamental study of summer and winter air conditioning including temperature, humidity, air velocity and distribution.

MAE 404 REFRIGERATION**3 (3-0) F****Prerequisite:** MAE 302

A thermodynamic analysis of the simple, compound, centrifugal and multiple effect compression systems, the steam jet system and the absorption system of refrigeration.

MAE 405 MECHANICAL ENGINEERING LABORATORY III**1 (0-3) F****Prerequisite:** MAE 306

The final course in the undergraduate mechanical laboratory sequence which exposes the student to case studies in experimental engineering, and provides him the opportunity to select instrumentation and design a complete experimental set up for a specific problem.

**MAE 409 PARTICULATE CONTROL IN INDUSTRIAL ATMOSPHERIC
POLLUTION****3 (3-0) S****Prerequisite:** MAE 301 or equivalent

Combustion calculations and analysis of particulate emission and gases from industrial and utility power stations burning various types of fuel. State and Federal pollution codes, requirements for compliance and enforcement. Calculations and design of industrial equipment to combat pollution. Utilization of waste products from industrial plants.

- MAE 411 MECHANICAL DESIGN I** 3 (3-0) F
 Prerequisites: MAE 315, MAE 316
 Application of the engineering and materials sciences to the analysis and design of mechanical components including screws and fasteners, antifriction and journal bearings, springs, gears, shafts, clutches, breaks and couplings, etc.
- MAE 415 MECHANICAL ENGINEERING ANALYSIS** 3 (3-0) F
 Prerequisites: MAE 302, MAE 315, MAE 316, EE 331
 Consideration of a logical method of problem solving through the integration of the physical sciences, engineering sciences and mathematics and their use in a rigorous training in methods of analysis of real mechanical engineering problems.
- MAE 416 MECHANICAL ENGINEERING DESIGN** 4 (3-2) S
 Prerequisite: MAE 415
 Application of the engineering and materials sciences to the total design of mechanical engineering components and systems. Consideration and utilization of the design process including problem definition, solution synthesis, design analysis, optimization and prototype evaluation through design project activity.
- MAE 431 THERMODYNAMICS OF FLUID FLOW** 3 (3-0) F
 Prerequisites: MA 301, MAE 302, EM 303 or MAE 355
 The fundamental dynamics and thermodynamic principles governing the flow of gases are presented from both theoretical and experimental viewpoints. Mathematical relations are closely correlated with physical phenomena to emphasize the complementary nature of theory and experiment.
- MAE 435 PRINCIPLES OF AUTOMATIC CONTROL** 3 (3-0) F S
 Prerequisite: MA 301
 Study of linear feedback control systems using transfer functions. Transient and steady-state responses. Stability analysis using rootlocus and frequency response techniques (Bode plots and Nyquist diagrams). Active and passive compensation methods. Preliminary design and analysis of typical mechanical and aerospace automatic control systems.
- MAE 450 INTRODUCTION TO VACUUM TECHNOLOGY** 3 (2-3) F S
 Prerequisite: MAE 301
 An introduction to the physical phenomena and apparatus associated with vacuum technology and rarefied gas research. Instruction in the use of vacuum laboratory equipment and demonstration of basic rarefied gas phenomena will be emphasized.
- MAE 462 FLIGHT VEHICLE STABILITY AND CONTROL** 3 (3-0) F
 Prerequisite: MAE 361
 Linearized dynamic analysis of the motion of a six degree-of-freedom flight vehicle in response to control inputs and disturbance through use of the transfer function concept. Control of dynamic behavior by vehicle design (stability derivatives) and/or flight control systems.
- MAE 465, 466 AEROSPACE ENGINEERING LABORATORY** 1 (0-3) F S
 Prerequisite: MAE 356
 Laboratory experience in wind tunnel experimentation, including the measurement of pressure distributions, forces and moments on models of both components and entire aircraft and missiles.
- MAE 467 ROCKET PROPULSION** 3 (3-0) F
 Prerequisite: MAE 365
 Performance analysis and design of liquid fuel, solid fuel, nuclear and electrical rocket propulsion systems.

MAE 471 (MAS 471) UNDERSEA VEHICLE DESIGN 3 (3-0) F S
Prerequisite: MAE 355 or EM 302

An introduction to the solution of problems encountered in the design of both submerged and semisubmerged ocean vehicles. Included are discussions and analytical treatments of vehicle drag and lift, buoyancy effects, vehicle propulsion and systems integration.

MAE 472 AEROSPACE VEHICLE STRUCTURES II 4 (3-3) F
Prerequisite: MAE 371

A continuation of MAE 471 with emphasis on specialized topics such as semino-mo-coque structures, deflection of structures, indeterminate structures, torsion analysis. A laboratory is included to demonstrate the theory and application of resistance strain gages, and to provide an opportunity for actual load-stress-deflection tests on typical flight vehicle structure components, as well as the determination of basic material properties, and correlation of tests and analytical results.

MAE 479 AEROSPACE VEHICLE DESIGN 4 (2-6) S
Prerequisites: MAE 356, MAE 462, MAE 467, MAE 472, EE 332

A synthesis of all previously acquired theoretical and empirical knowledge and application to the design of practical aerospace vehicle systems.

**MAE 495 TECHNICAL SEMINAR IN MECHANICAL AND AEROSPACE
ENGINEERING** 1 (1-0) FS
Prerequisite: Senior standing

Meetings once a week for the delivery and discussion of student papers on topics of current interest in mechanical engineering.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MAE 501 STEAM AND GAS TURBINES 3 (3-0) FS
Prerequisites: MAE 302, EM 303 or MAE 355

Fundamental analysis of the theory and design of turbomachinery flow passages; control and performance of turbomachinery; gas-turbine engine processes.

MAE 507, 508 INTERNAL COMBUSTION ENGINE FUNDAMENTALS 3 (3-0) FS
Prerequisite: MAE 302

The fundamentals common to internal combustion engine cycles of operation. The Otto engine: carburetion, fuel distribution, flame and spark timing, and altitude effects; the Diesel engine; injection knock, combustion, precombustion and scavenging as applied to reciprocating and rotary engines.

MAE 513 VIBRATION AND NOISE CONTROL 3 (2-3) F
Prerequisite: MAE 315 or MAE 472

This course will be devoted to a study of the nature and origin of vibration and noise in mechanical systems and design for their control. Considerations will include source reduction, isolation, transmission, damping and acoustic shielding techniques, through classroom discussions and laboratory demonstrations.

MAE 515 EXPERIMENTAL STRESS ANALYSIS 3 (2-3) F
Prerequisite: MAE 316

Theoretical and experimental techniques of strain and stress analysis with emphasis on electrical strain gages and instrumentation, brittle coatings, grid methods and an introduction to photoelasticity. Laboratory includes an investigation and complete report of a problem chosen by the student under the guidance of the instructor.

MAE 516 PHOTOELASTICITY**3 (2-3) S****Prerequisite:** MAE 316

Theory and experimental techniques of two- and three-dimensional photoelasticity including photoelastic coatings, photoplasticity and an application of photoelastic methods to the solution of mechanical design problems. Laboratory includes an investigation and complete report of a problem chosen by the student under the guidance of the instructor.

MAE 517 LUBRICATION**3 (2-3) S****Prerequisite:** EM 303

The theory of hydrodynamic lubrication; Reynold's equation, the Sommerfield integration, effect of variable lubricant properties and energy equation for temperature rise. Properties of lubricants. Application to design of bearings. Boundary lubrication. Solid film lubrication.

MAE 518 ACOUSTIC RADIATION I**3 (3-0) F S****Prerequisite:** MA 301

Discussion of the principles of acoustic radiation as related to acoustic sources and their related fields. The radiation of single sources (point, plane, line cylinder, spheres, etc.) and combinations thereof are considered.

MAE 521 AEROTHERMODYNAMICS**3 (3-0) F S****Prerequisites:** MAE 301, MAE 355 or EM 303

Review of basic thermodynamics pertinent to gas dynamics. Detailed development of the general equations governing gas motion in both differential and integral form. Simplification of the equations to those for specialized flow regimes. Similarity parameters. Applications to simple problems in various flow regimes.

MAE 531 PLASMAGASDYNAMICS I**3 (3-0) F S****Prerequisites:** MAE 356, PY 414

Study of basic laws governing plasma motion for dense and rarefied plasmas, hydromagnetic shocks, plasma waves and instabilities, simple engineering applications.

MAE 532 PLASMAGASDYNAMICS II**3 (3-0) F S****Prerequisite:** MAE 531

Quantum statistics and ionization phenomena. Charged particles interactions. Transport properties in the presence of electric and magnetic fields and nonequilibrium ionization.

MAE 535 (EE 535) GAS LASERS**3 (3-0) F S****Prerequisites:** MAE 353 or equivalent, PY 407

Study of the principles, design and potential applications of ion, molecular, chemical and atomic gas lasers.

MAE 541, 542 AERODYNAMIC HEATING**3 (3-0) F S****Prerequisites:** MA 511, MAE 521

A detailed study of the latest theoretical and experimental findings of the compressible laminar and turbulent boundary layers with special attention to the aerodynamic heating problem. Application of theory in the analysis and design of aerospace hardware.

MAE 543 HEAT TRANSFER—THEORY AND APPLICATIONS**3 (3-0) F S****Prerequisite:** MAE 402 or equivalent

Development of basic equations for steady and transient heat and mass transfer processes. Emphasis is placed on the applications of the basic equations to engineering problems in the areas of conduction, convection, mass transfer and thermal radiation.

MAE 545, 546 PROJECT WORK IN MECHANICAL ENGINEERING I, II 2 (0-4) F S

Individual or small group investigation of a problem stemming from a mutual student-faculty interest. Emphasis is placed on providing a situation for exploiting student curiosity.

MAE 550 CRYOGENICS I 3 (3-0) F S
Prerequisite: MAE 402

A study of the thermodynamic processes required to produce cryogenic fluids. Properties of materials at cryogenic temperatures. Insulation of cryogenic vessels and lines. Design of cryogenic systems.

MAE 554 ADVANCED AERODYNAMIC THEORY 3 (3-0) S
Prerequisite: MAE 355

Development of fundamental aerodynamic theory. Emphasis upon mathematical analysis and derivation of equations of motion, airfoil theory and comparison with experimental results. Introduction to supersonic flow theory.

MAE 555 ADVANCED FLIGHT VEHICLE STABILITY AND CONTROL 3 (3-0) F
Prerequisite: MAE 462

Preliminary analysis and design of flight control systems to include autopilots and stability argumentation systems. Study of effects of inertial cross-coupling and nonrigid bodies on vehicle dynamics.

MAE 562 ADVANCED AIRCRAFT STRUCTURES 3 (3-0) S
Prerequisite: MAE 371

Development of methods of stress analysis for aircraft structures, special problems in structural design, stiffened panels, rigid frames, indeterminate structures, general relaxation theory.

MAE 571 INERTIAL GUIDANCE, DESIGN AND ANALYSIS 3 (3-0) S
Prerequisites: MA 401, MAE 435 or MAE 462

Engineering design and performance analysis of inertial guidance components, subsystems and systems. Development of transfer functions and application of linear system techniques to determine stability, transient response and steady-state errors of gyros, accelerometers, stable platforms and initial alignment subsystems. Error analysis and its significance. Preliminary design and analysis of typical inertial guidance systems for flight and marine vehicles.

MAE 581, 582 HYPERSONIC AERODYNAMICS 3 (3-0) F S
Prerequisites: MA 512, MAE 521 or equivalent

A detailed study of the latest theoretical and experimental findings in hypersonic aerodynamics.

MAE 593 SPECIAL TOPICS IN MECHANICAL ENGINEERING 3 (3-0) F S
Prerequisite: Advanced undergraduate or graduate standing

Faculty and student discussions of special topics in mechanical engineering.

FOR GRADUATES ONLY

MAE 601 ADVANCED ENGINEERING THERMODYNAMICS 3 (3-0) F

MAE 602 STATISTICAL THERMODYNAMICS 3 (3-0) S

MAE 603 ADVANCED POWER PLANTS 3 (3-0) F

MAE 605 AEROTHERMOCHEMISTRY 3 (3-0) S

MAE 606	ADVANCED GAS DYNAMICS	3 (3-0) S
MAE 608	ADVANCED HEAT TRANSFER I	3 (3-0) F
MAE 609	ADVANCED HEAT TRANSFER II	3 (3-0) S
MAE 610	ADVANCED TOPICS IN HEAT TRANSFER	3 (3-0) S
MAE 611, 612	ADVANCED MACHINE DESIGN I, II	3 (3-0) F S
MAE 613	MECHANICS OF MACHINERY	3 (3-0) F
MAE 614	MECHANICAL TRANSIENTS AND MACHINE VIBRATIONS	3 (3-0) S
MAE 615	AEROELASTICITY I	3 (3-0) F
MAE 617	MECHANICAL SYSTEM DESIGN ANALYSIS	3 (3-0) F
MAE 618	MECHANICAL SYSTEM DESIGN SYNTHESIS	3 (3-0) S
MAE 619	RANDOM VIBRATION	3 (3-0) F S
MAE 622	ACOUSTIC RADIATION II	3 (3-0) F S
MAE 625, 626	DIRECT ENERGY CONVERSION	3 (3-0) F S
MAE 631	APPLICATIONS OF ULTRASONICS TO ENGINEERING RESEARCH	3 (3-0) F
MAE 651	PRINCIPLES OF FLUID MOTION	3 (3-0) F
MAE 652	DYNAMICS OF COMPRESSIBLE FLOW	3 (3-0) F
MAE 653	SUPERSONIC AERODYNAMICS	3 (3-0) S
MAE 654	DYNAMICS OF VISCOUS FLUIDS I	3 (3-0) F
MAE 655	DYNAMICS OF VISCOUS FLUIDS II	3 (3-0) S
MAE 657	MEASUREMENT IN RAREFIED GAS STREAMS	3 (3-0) F
MAE 658, 659	MOLECULAR GAS DYNAMICS	3 (3-0) F S
MAE 661, 662	AEROSPACE ENERGY SYSTEMS	3 (3-0) F S
MAE 663 (TX 663)	MECHANICS OF TWISTED STRUCTURES	3 (3-0) F
MAE 664 (TX 664)	MECHANICS OF FABRIC STRUCTURES	3 (3-0) S
MAE 671, 672	ADVANCED AIR CONDITIONING DESIGN I, II	3 (3-0) F S
MAE 674, 675	ADVANCED SPACECRAFT DESIGN	3 (3-0) F S
MAE 681	INTRODUCTION TO ROCKET PROPULSION	3 (3-0) F
MAE 682	SOLID PROPELLANT ROCKETS	3 (3-0) S
MAE 683	LIQUID PROPELLANT ROCKETS	3 (3-0) S
MAE 684	ION PROPULSION	3 (3-0) F S

MAE 693	ADVANCED TOPICS IN MECHANICAL ENGINEERING	1-6 F or S
MAE 695	MECHANICAL ENGINEERING SEMINAR	1 (1-0) F or S
MAE 699	MECHANICAL ENGINEERING RESEARCH	Credits Arranged

METEOROLOGY

FOR ADVANCED UNDERGRADUATES

MY 201 ATMOSPHERIC ENVIRONMENT 3 (3-0)
Prerequisite: High school physics, chemistry, algebra, trigonometry or equivalent

A survey course on man's atmospheric environment designed to meet general needs in modern college education. Subjects include the nature and processes of the atmosphere, the interactions with land, sea, and life at the surface, the relations to other components of the solar system; measurements and surveillance of the atmosphere and relations to climatology, weather forecasting, weather modification and air pollution, and applications to various human activities.

MY 411 INTRODUCTORY METEOROLOGY 3 (3-0) F
Prerequisites: PY 206, PY 208 or PY 212; MA 201 or MA 212

The physical setting: coordinates, planetary motion, gravitation; composition and structure of the atmosphere; insolation and diurnal phenomena; heat balance of the atmosphere; consequent distribution of variables of state, motion and weather.

MY 412 ATMOSPHERIC PHYSICS 3 (3-0) S
Prerequisite: MY 411 or consent

Atmospheric effects on electromagnetic and acoustic transmission, and the consequent phenomena; terrestrial radiation; radar meteorology, visibility; atmospheric electricity and magnetism.

MY 421 ATMOSPHERIC STATICS AND THERMODYNAMICS 3 (3-0) F
Prerequisites: PY 206, PY 208 or PY 212; MA 202

The variables of state and thermodynamics of dry and moist air in the atmospheric system; water phase changes; hydrostatics and altimetry; stability, convection and diffusion; transfers at the surface; natural modifications of air.

MY 422 ATMOSPHERIC KINEMATICS AND DYNAMICS 3 (3-0) S
Prerequisites: PY 207 or PY 208; MA 202
Corequisite: MY 421 or consent

Properties and fields of atmospheric motion, and variations with time; forces and force fields; equilibrium and accelerated motions; the boundary layer and momentum transfer; continuity, pressure tendency and divergence-vorticity theorems.

MY 435 MEASUREMENTS AND DATA SYSTEMS 3 (2-3) S
Prerequisite: MY 421

Meteorological instruments, observations and networks; data communications, reduction and presentation; meteorological charts and diagrams, fundamental analysis of physical distributions.

MY 441 METEOROLOGICAL ANALYSIS I 3 (3-0) F
Prerequisites: MY 421, MY 422, MY 435

Theory and analysis of atmospheric distributions, processes and developments in the three-space dimensions and time.

MY 443 METEOROLOGICAL LABORATORY I 4 (0-10) F
 Prerequisite: MY 435
 Corequisite: MY 441

Laboratory course in analysis of atmospheric distributions, processes and developments, employing regularly available meteorological data and the principles presented in prerequisite and corequisite courses. The purpose is to gain working knowledge of integrated atmospheric systems and processes through detailed analyses of natural situations.

MY 444 METEOROLOGICAL LABORATORY II 4 (0-10) S
 Prerequisite: MY 443

Laboratory course in analysis and application of principles and concepts for predicting developments in the weather.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MY 512 MICROMETEOROLOGY 3 (3-0) F
 Prerequisite: MY 422

Meteorology of the lowest hundred meters of the atmosphere with emphasis on the transport of momentum, heat, water vapor, and effluents and their transfer through the earth's surface.

MY 521 THE UPPER ATMOSPHERE 3 (3-0) S
 Prerequisite: MY 411 or consent of instructor

Meteorological conditions in the upper atmosphere from the stratosphere to the ionosphere. Compositions, mean distributions and variabilities, and circulation and transport properties in the region. Physical theories.

MY 555 METEOROLOGY OF THE BIOSPHERE 3 (3-0) F
 Prerequisites: PY 205, or PY 211; CH 103 or CH 107; MA 102 or MA 112

A course designed for graduate students in the life sciences, presenting the physical principles governing the states and processes of the atmosphere in contact with earth's surface of land, water, and life. Exchanges of heat, mass, and momentum are analyzed for various conditions of the atmosphere and surface, and as a function of season, time, and geographic location.

MY 556 AIR POLLUTION METEOROLOGY 3 (3-0) S
 Prerequisite: MY 555 or equivalent

The meteorological aspects of air pollution, especially for nonmeteorologists engaged in graduate training for work involving air pollution.

MY 593 ADVANCED TOPICS 1-6 F S
 Prerequisite: Consent of staff

Special topics of advanced nature in the field of meteorology, provided to groups or assigned to individual students.

FOR GRADUATES ONLY

MY 612 ATMOSPHERIC RADIATIVE TRANSFER 3 (3-0) S

MY 627 ATMOSPHERIC TURBULENCE AND DIFFUSION 3 (3-0) F

MY 635 DYNAMICAL ANALYSIS OF THE ATMOSPHERE 3 (2-3) F

MY 695 SEMINAR

1 (1-0) F S

MY 699 RESEARCH

Credits Arranged FS

MICROBIOLOGY

FOR UNDERGRADUATES

MB 301 MICROBIAL LIFE

3 (3-0) Sum.

An introduction to the basic concepts of microbiology at an elementary level requiring no college-level prerequisites in chemistry or biology. Although given as a terminal course, it emphasizes modern fundamental knowledge and concepts in sufficient depth that superior students may take MB 302 and organic chemistry and then take MB 501. Students cannot receive credit for both MB 301 and MB 401.

Mr. Hayes

MB 302 CLINICAL MICROBIOLOGY LAB

1 (0-2) Sum.

Corequisite: MB 301

Techniques of isolating and characterizing microorganisms of medical significance. For student nurses and other paramedical students.

Mr. Hayes

FOR ADVANCED UNDERGRADUATES

MB 401 GENERAL MICROBIOLOGY

4 (3-3) S

Prerequisites: BS 100, CH 223 or CH 220

A rigorous introduction to the basic principles and concepts of modern microbiology. This course is recommended for students in the biological sciences and agricultural sciences curricula and for all students who plan to take further courses in microbiology. Credit will not be granted for both MB 301 and MB 401.

Mr. Elkan

MB 405 (FS 405) FOOD MICROBIOLOGY

3 (2-3) F

(See food science, page 318.)

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MB 501 ADVANCED MICROBIOLOGY

4 (3-2) F

Prerequisite: MB 401

A study in some depth of microbial structure and function, host-parasite relationships, microbial ecology and characterization of important groups of microorganisms.

Messrs. Lecce, Perry

MB 506 (FS 506) ADVANCED FOOD MICROBIOLOGY

3 (1-6) S

(See food science, page 319.)

MB 514 MICROBIAL METABOLISM

4 (3-2) S

Prerequisites: MB 401, BCH 351 or BCH 551

A study of the physiology and metabolism of microorganisms and their regulatory mechanisms.

Messrs. Dobrogosz, McNeill

MB 532 (SSC 532) SOIL MICROBIOLOGY

3 (3-0) S

(See soil science, page 436.)

MB 555 (ZO 555) PROTOZOOLOGY (See zoology, page 461.)	4 (2-6) F
MB 561 (GN 561, BCH 561) BIOCHEMICAL AND MICROBIAL GENETICS (See biochemistry, page 248.)	3 (3-0) F
MB 570 (CE 570) SANITARY MICROBIOLOGY (See civil engineering, page 272.)	3 (2-3) S
MB 571 VIROLOGY Prerequisites: BCH 551, MB 401	3 (3-0) S
An introduction to the fundamental aspects of virus-cell interactions. These include virus attachment and penetration, intracellular virus replication, metabolic changes occurring in cells as a result of virus infection and virus-induced cellular transformations. Mr. Hayes	
MB 574 (BO 574) PHYCOLOGY (See botany, page 256.)	3 (1-4) S
MB 575 (BO 575, PP 575) THE FUNGI (See botany, page 256.)	3 (3-0) S
MB 576 (BO 576, PP 576) THE FUNGI LAB (See botany, page 256.)	1 (0-3) S
MB 590 TOPICAL PROBLEMS Prerequisites: Consent of instructor, graduate standing	Credits Arranged F S

Topics presented by a visiting professor or special lecturer. This will be used to develop new courses or to take advantage of special competence of resident or visiting faculty members.

FOR GRADUATES ONLY

MB 632 (SSC 632) ECOLOGY AND FUNCTIONS OF SOIL MICROORGANISMS	3 (3-0) S
MB 690 MICROBIOLOGY SEMINAR	1 (1-0) F S
MB 692 SPECIAL PROBLEMS IN MICROBIOLOGY	Credits Arranged F S
MB 699 MICROBIOLOGY RESEARCH	Credits Arranged F S

MILITARY TRAINING

AEROSPACE STUDIES (Air Force ROTC)

GENERAL MILITARY EDUCATION

AS 121 AEROSPACE STUDIES 100	1 (1-1) F
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This is the initial course of study in the four-year AFROTC curriculum. This course is designed to familiarize the student with the mission, organization and doctrine of the U.S. Air Force, U.S. Strategic Offensive Forces and introduction to U.S. Strategic Defensive Forces. Corps training provides the cadet with experience in executing drill movements, knowledge of customs and courtesies expected of an Air Force member, career opportunities in the Air Force, and the life and work of an Air Force junior officer.

AS 122 AEROSPACE STUDIES 100 1 (1-1) S
Prerequisite: AS 121 or equivalent

Continues the study of U. S. Strategic Defensive Forces, U. S. General Purpose and Aerospace Support Forces including those of the Army, Navy and Marines. Corps training continues to stress emphasis on basic fundamentals needed for the cadet to be capable of assuming and discharging his responsibilities in future AFROTC functions and as a professional officer.

AS 221 AEROSPACE STUDIES 200 1 (1-1) F
Prerequisite: AS 122 or equivalent

Study of the organization of the Department of Defense and the role of the military in national policies. Basic familiarization with defense policies including study of the nature and principles of war. General and limited warfare covered as preparation for future discussion of U. S. defense policies. Corps training continues to develop skills learned in AS 100 and furthers study of junior officer environment.

AS 222 AEROSPACE STUDIES 200 1 (1-1) S
Prerequisite: AS 221 or equivalent

Study involves survey of Soviet and Chinese military policy, role of alliances in U. S. defense policy, and some of the various elements and processes in the making of defense policy. Corps training continues to develop leadership skills and study of junior officer environment.

PROFESSIONAL OFFICER EDUCATION PROGRAM

AS 321 AEROSPACE STUDIES 300 1 (3-1) F
Prerequisite: Four year ROTC cadets, AS 222; two year, nonveteran students, attendance at a six-week field training

This course is designed to increase knowledge and awareness of important phases and personalities in the development of airpower. It begins with the first efforts in ballooning and ends in the early 1960's. Latter portions of the course emphasize organization growth and doctrinal development of today's Aerospace Forces. Considerable opportunity is given to practice communicative skills as an integral part of course activities. Leadership in military drill and command is practiced in the laboratory period.

AS 322 AEROSPACE STUDIES 300 2 (3-1) S
Prerequisite: AS 321

This is a study of astronautics and space operations. It is a relatively nontechnical review of the national (US) space effort, the spatial environment and space orbits and trajectories. Space vehicle systems including structures, propulsion, electric power, guidance, communications, ground support and "Man in Space" are reviewed on the same nontechnical level. US space operations and our future developments are also reviewed. Continued military leadership opportunities are provided in the laboratory period.

AS 421 AEROSPACE STUDIES 400 1 (3-1) F
Prerequisite: AS 322

Class and laboratory include an exploration and practical experience in the need for leadership and a study of human behavior and relations that relate to military leadership. Also included is a study of professional self-discipline, imposed discipline of military law and examination of the variables affecting leadership. At all times emphasis is placed on the development of communicative skills and what the student needs to know as a future junior officer of the United States Air Force.

Prerequisite: AS 421

Class and laboratory include a study and practical experience in military management functions. Also a development of normal command and staff functioning in problem solving, advising and decision-making situations. At all times emphasis is placed on the development of communicative skills, leadership abilities and what the student needs to know as a future junior officer of the United States Air Force.

FIELD TRAINING COURSES

AFROTC field training is offered during the summer months at selected Air Force bases throughout the United States. Students in the four-year program participate in four weeks of field training during the summer after their sophomore or junior year. Students applying for entry into the two-year program must successfully complete six weeks of field training prior to enrollment in AFROTC.

The major areas of study in the four-week field training program include junior officer training, aircraft and aircrew indoctrination, career-orientation, survival training, base functions and Air Force environment, and physical training.

The major areas of study included in the six-week field training program are essentially the same as those conducted in subject matter that four-year program students received in the General Military Course, including corps training, during their freshman and sophomore years of on-campus AFROTC enrollment.

MILITARY SCIENCE (Army ROTC)

THE BASIC COURSE

MS 101 MILITARY SCIENCE I

1 (1-1) F

Classroom instruction is given in the U. S. Defense Establishment to include the history, mission and organization of the ROTC program and instruction in individual weapons and marksmanship. On the drill field, emphasis is placed on development of teamwork, esprit de corps and essential characteristics of leadership.

MS 102 MILITARY SCIENCE I

1 (1-1) S

Classroom instruction is given in the U. S. Defense Establishment to include a study of the organization of the Department of Defense and the U. S. Army. On the drill field emphasis is placed on development of teamwork, esprit de corps and essential characteristics of leadership.

MS 201 MILITARY SCIENCE II

1 (2-1) F

Prerequisites: MS 101, MS 102 or equivalent

Classroom instruction in American military history. On the drill field emphasis is placed on development of teamwork, esprit de corps, essential characteristics of leadership and acceptance of responsibility.

MS 202 MILITARY SCIENCE II

1 (2-1) S

Prerequisites: MS 101, MS 102 or equivalent

Classroom instruction in map and aerial photograph reading and introduction to operation and basic tactics. On the drill field, emphasis is placed on development of teamwork, esprit de corps, essential characteristics of leadership and acceptance of responsibility.

THE ADVANCED COURSE

MS 301 MILITARY SCIENCE III

1 (2-1) F

Prerequisites: MS 101, MS 102, MS 201, MS 202 or equivalent

Classroom instruction is given in military leadership, emphasizing the factors controlling the soldiers' behavior and the problems of command; methods of military instruction, with emphasis placed on the leaders' responsibility for the soldier's learning; practical leadership instruction is provided on the drill field where emphasis is placed on acceptance of responsibility, exercise of command and development of self-confidence.

MS 302 MILITARY SCIENCE III

2 (2-1) S

Prerequisites: MS 101, MS 102, MS 201, MS 202, or equivalent, MS 301

Classroom instruction is given in the missions and function of the branches of the Army prior to their ROTC summer camp and selection of branch in their senior year; principles of military planning and the conduct of offensive and defensive operations plus communication support. Practical leadership instruction is provided on the drill field where emphasis is placed on acceptance of responsibility, exercise of command and development of self-confidence.

MS 401 MILITARY SCIENCE IV

1 (2-1) F

Prerequisites: MS 301, MS 302

Classroom instruction is given in military justice, the United States in today's world, command and staff organization and functions and military intelligence. On the drill field emphasis is placed on the exercise of command, planning and executing all phases of training and maximum development of teamwork, esprit de corps and leadership characteristics.

MS 402 MILITARY SCIENCE IV

2 (2-1) S

Prerequisites: MS 301, MS 302, MS 401

Classroom instruction is given in operational techniques, military team tactics, map and aerial photograph reading, logistics and internal defense development. These subjects prepare the cadet to immediately enter on active duty upon graduation with adequate qualification to attend basic branch school. On the drill field emphasis is placed on the exercise of command, planning and executing all phases of training and maximum development of teamwork, esprit de corps and leadership.

MODERN LANGUAGES

Note: Courses numbered 200 and above need not be followed as a sequence in their respective gamut. Two years of high school languages will normally be considered the equivalent of one year of college instruction in that language.

ENGLISH (Foreign Students)

MLE 101 ENGLISH FOR FOREIGN STUDENTS: REVIEW GRAMMAR

3 (3-0) F S

Emphasis in this course is laid upon the pronunciation, grammar and comprehension of American English.

MLE 102 ENGLISH FOR FOREIGN STUDENTS: COMPOSITION

3 (3-0) F S

Emphasis in this course is laid upon the writing of American English, grammatical exercises, sentence structure, spelling and diction.

MLE 103 ENGLISH FOR FOREIGN STUDENTS: CONVERSATION 3 (3-0) F S

Designed for foreign students who have studied formal English but who need oral practice in informal speech to understand it and speak it with ease and fluency. Emphasis is placed on correct pronunciation, intonation (rhythm and stress in words and sentences), drill on the basic patterns of English sentences and idiomatic expressions by means of oral classroom drills, conversations about current issues, and individual and/or supervised practice in the language laboratory.

FRENCH

MLF 101 ELEMENTARY FRENCH I 3 (3-0) F S

MLF 102 ELEMENTARY FRENCH II 3 (3-0) F S
Prerequisite: MLF 101 or equivalent

MLF 200 REVIEW GRAMMAR AND COMPOSITION 3 (3-0) F S
Prerequisite: MLF 102 or equivalent

This course will bridge the gap between basic grammar courses and the more advanced literary courses preparing the student for the type of composition and conversation expected of him in the latter. It will also offer an opportunity for students with previous knowledge of language from secondary schools to review grammar and obtain experience in an area not normally covered in their high school work.

MLF 201 FRENCH CIVILIZATION 3 (3-0) F S
Prerequisite: MLF 102 or equivalent

Readings in the history and customs of France, supplemented by lectures on such topics as language, arts, science, philosophy, etc. Parallel readings and reports.

MLF 202 FRENCH PROSE: SELECTIONS FROM MODERN FRENCH LITERATURE 3 (3-0) F S
Prerequisite: MLF 102 or equivalent

MLF 301 SURVEY OF FRENCH LITERATURE, ORIGINS TO 1800 3 (3-0) F S
Prerequisite: Six hours intermediate French

MLF 302 SURVEY OF FRENCH LITERATURE, 1800 TO PRESENT 3 (3-0) F S
Prerequisite: Six hours intermediate French

MLF 309 ADVANCED FRENCH CONVERSATION AND PHONETICS 3 (3-0) F S
Prerequisite: Six hours intermediate French or equivalent

Conversation on an advanced level based on materials read outside and material presented through film and tape in the language laboratory.

MLF 323 CONTEMPORARY FRENCH NOVEL 3 (3-0) F S
Prerequisite: Six hours intermediate French

MLF 411 FRENCH LITERATURE OF THE 17TH CENTURY 3 (3-0) F S
Prerequisite: Consent of instructor

MLF 412 FRENCH LITERATURE OF THE 18TH CENTURY 3 (3-0) F S
Prerequisite: Consent of instructor

MLF 491 SPECIAL TOPICS IN FRENCH STUDIES 3 (3-0) F S
Prerequisite: Consent of department

MLF 492	SPECIAL TOPICS IN FRENCH STUDIES	3 (3-0) F S
Prerequisite: Consent of department		
MLF 498	SPECIAL TOPICS IN FRENCH	1-6
Prerequisite: Six hours of French above the elementary level		

FOR GRADUATE CERTIFICATION

MLF 401	FRENCH GRAMMAR FOR GRADUATE STUDENTS	3 (3-0) F S
This course is designed to present the grammar of scientific French as rapidly as possible in preparation for the reading course which follows.		

MLF 402	SCIENTIFIC FRENCH	3 (3-0) F S
Prerequisite: MLF 401 or equivalent		

Reading and translation of technical French, supplemented by discussions on terminology, word order, vocabulary analysis and other linguistic techniques. Subject material adjusted to individual needs; conferences.

GERMAN

MLG 101	ELEMENTARY GERMAN I	3 (3-0) F S
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MLG 102	ELEMENTARY GERMAN II	3 (3-0) F S
Prerequisite: MLG 101 or equivalent		

MLG 200	REVIEW GRAMMAR AND COMPOSITION	3 (3-0) F S
Prerequisite: MLG 102 or equivalent		

This course will bridge the gap between basic grammar courses and the more advanced literary courses preparing the student for the type of composition and conversation expected of him in the latter. It will also offer an opportunity for students with previous knowledge of a language from secondary schools to review grammar and obtain experience in an area not normally covered in their high school work.

MLG 201	GERMAN PROSE: SELECTIONS FROM MODERN GERMAN LITERATURE	3 (3-0) F S
Prerequisite: MLG 102 or equivalent		

MLG 202	GERMAN CIVILIZATION	3 (3-0) F S
Prerequisite: MLG 102 or equivalent		

Readings in the history and customs of Germany, supplemented by lectures on such topics as language, arts, science, philosophy, etc. Parallel readings and reports.

MLG 301	SURVEY OF GERMAN LITERATURE, ORIGINS TO 1900	3 (3-0) F S
Prerequisite: Six hours intermediate German		

MLG 302	SURVEY OF GERMAN LITERATURE, 1900 TO PRESENT	3 (3-0) F S
Prerequisite: Six hours intermediate German		

MLG 309	ADVANCED GERMAN CONVERSATION AND PHONETICS	3 (3-0) F S
Prerequisite: Six hours intermediate German or equivalent		

MLG 322	MAJOR GERMAN MODERN WRITERS	3 (3-0) F S
Prerequisite: Six hours intermediate German		

MLG 323 CONTEMPORARY GERMAN LITERATURE	3 (3-0) F S
Prerequisite: One year intermediate German	

MLG 498 SPECIAL TOPICS IN GERMAN	1-6
Prerequisites: Six hours of German above the elementary level	

FOR GRADUATE CERTIFICATION

MLG 401 GERMAN GRAMMAR FOR GRADUATE STUDENTS	3 (3-0) F S
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This course is open to graduate students and is designed to present the grammar of scientific German as rapidly as possible in preparation for the reading course which follows.

MLG 402 SCIENTIFIC GERMAN	3 (3-0) F S
Prerequisite: MLG 401 or equivalent	

Reading and translation of technical German, supplemented by discussions on terminology, word order, vocabulary analysis and other linguistic techniques. Subject material adjusted to individual needs; conferences.

ITALIAN

MLI 101 ELEMENTARY ITALIAN I	3 (3-0) F S
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MLI 102 ELEMENTARY ITALIAN II	3 (3-0) F S
Prerequisite: MLI 101 or equivalent	

MLI 201 ITALIAN PROSE, SELECTIONS FROM ITALIAN LITERATURE	3 (3-0) F S
Prerequisite: MLI 102 or equivalent	

MLI 202 ITALIAN CIVILIZATION	3 (3-0) F S
Prerequisite: MLI 102 or equivalent	

RUSSIAN

MLR 101 ELEMENTARY RUSSIAN I	3 (3-0) F S
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MLR 102 ELEMENTARY RUSSIAN II	3 (3-0) F S
Prerequisite: MLR 101 or equivalent	

MLR 201 RUSSIAN PROSE: SELECTIONS FROM RUSSIAN LITERATURE	3 (3-0) F S
Prerequisite: MLR 102 or equivalent	

MLR 202 RUSSIAN CIVILIZATION	3 (3-0) F S
Prerequisite: MLR 102 or equivalent	

SPANISH

MLS 101 ELEMENTARY SPANISH I	3 (3-0) F S
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MLS 102 ELEMENTARY SPANISH II	3 (3-0) F S
Prerequisite: MLS 101 or equivalent	

MLS 200	REVIEW GRAMMAR AND COMPOSITION	3 (3-0) F S
Prerequisite: MLS 102 or equivalent		
This course will bridge the gap between basic grammar courses and the more advanced literary courses preparing the student for the type of composition and conversation expected of him in the latter. It will also offer an opportunity for students with previous knowledge of a language from secondary schools to review grammar and obtain experience in an area not normally covered in their high school work.		
MLS 201	SPANISH CIVILIZATION	3 (3-0) F S
Prerequisite: MLS 102 or equivalent		
Comprehensive picture of the culture, geography, history and economy of Spain.		
MLS 202	HISPANO-AMERICAN CIVILIZATION	3 (3-0) F S
Prerequisite: MLS 102 or equivalent		
Comprehensive picture of the culture, geography, history and economy of the Spanish-American countries.		
MLS 301	SURVEY OF SPANISH LITERATURE, ORIGINS THROUGH GOLDEN AGE	3 (3-0) F S
Prerequisite: Six hours intermediate Spanish		
MLS 302	SURVEY OF SPANISH LITERATURE, 18TH CENTURY TO PRESENT	3 (3-0) F S
Prerequisite: Six hours intermediate Spanish		
MLS 303	LATIN AMERICAN LITERATURE I	3 (3-0) F S
Prerequisite: Six hours intermediate Spanish		
MLS 304	LATIN AMERICAN LITERATURE II	3 (3-0) F S
Prerequisite: Six hours intermediate Spanish		
MLS 309	ADVANCED SPANISH CONVERSATION AND PHONETICS	3 (3-0) F S
Prerequisite: Six hours intermediate Spanish or equivalent		
Conversation on an advanced level based on materials read outside and material presented through film and tape in the language laboratory.		
MLS 323	CONTEMPORARY SPANISH LITERATURE	3 (3-0) F S
Prerequisite: Six hours intermediate Spanish		
MLS 403	CERVANTES	3 (3-0) F S
Prerequisite: MLS 301, 302 or equivalent		
MLS 404	DRAMA OF THE GOLDEN AGE	3 (3-0) F S
Prerequisite: MLS 301, 302 or equivalent		
MLS 491	SPECIAL TOPICS IN SPANISH STUDIES	3 (3-0) F S
Prerequisite: Consent of department		
MLS 492	SPECIAL TOPICS IN SPANISH STUDIES	3 (3-0) F S
Prerequisite: Consent of department		
MLS 498	SPECIAL TOPICS IN SPANISH	1-6
Prerequisite: Six hours Spanish above the elementary level		

FOR GRADUATE CERTIFICATION

MLS 401 SPANISH GRAMMAR FOR GRADUATE STUDENTS 3 (3-0) F S

This course is designed to present the grammar of scientific Spanish as rapidly as possible in preparation for the reading course which follows.

MLS 402 SCIENTIFIC SPANISH 3 (3-0) F S

Prerequisite: MLS 401 or equivalent

Reading and translation of technical Spanish, supplemented by discussion on terminology, word order, vocabulary analysis and other linguistic techniques. Subject material adjusted to individual needs; conferences.

MUSIC

MUS 100 INSTRUMENTAL MUSIC 1 (0-5) FS

Prerequisite: Satisfactorily passing audition

Open to all students for the study and performance of the best in instrumental music. Assignments to the various organizations are made according to the interests and abilities of the individual.

MUS 110 CHORAL MUSIC 1 (0-4) FS

Prerequisite: Satisfactorily passing audition

Open to all students for the study and performance of the best in choral music. Assignments to the various organizations are made according to the interests and abilities of the individual.

MUS 200 MUSIC IN CONTEMPORARY LIFE 3 (3-0) FS

A course especially designed to assist students in developing their understanding of music as a vital part in today's life. Special emphasis on evaluating musical form and content, style periods, design and interpreting music as it relates to various aspects of today's society.

MUS 210 A SURVEY OF MUSIC IN AMERICA 3 (3-0) Sum.

A survey of the music in the United States from colonial times to the present, with particular emphasis on the major influences which have shaped the musical literature and culture of America.

MUS 220 MUSIC OF THE ROMANTIC PERIOD 3 (3-0) Sum.

A course designed to provide an insight into the significant musical trends of the Romantic Period (1800-1900). Subject matter will include an analysis of the prevailing musical forms, the styles of the composers, and the relation of music to other art forms.

MUS 320 MUSIC OF THE 20TH CENTURY 3 (3-0) Sum.

A study of representative music from 1900 to the present. Emphasis is upon musical ideas and materials. The traditions and innovations, as exemplified in the music of this century are examined.

NUCLEAR ENGINEERING

FOR ADVANCED UNDERGRADUATES

NE 201 APPLICATIONS OF NUCLEAR ENERGY

3 (3-0) S

Prerequisite: PY 206

A general introduction to the uses of nuclear energy. Topics include radioactivity, fission, chain reaction, power production, isotopes, radiation detection, radiation safety and peaceful applications of nuclear energy. This course is intended to give the student a broad perspective of nuclear engineering and to introduce fundamental principles and concepts that will be used in later courses.

Mr. Murray

NE 301 FUNDAMENTALS OF NUCLEAR ENERGY

4 (3-2) F

Prerequisite: PY 207

Introduction to the physical properties of the atomic nucleus as an energy source. Qualitative and quantitative coverage of radioactivity and nuclear reactions with emphasis on engineering applications. Elementary reactor principles are introduced with particular reference to neutron motion and the interactions of radiation with matter. Laboratory sessions aid in the understanding of basic phenomena and the operation of radiation detection equipment.

Mr. Kiker

NE 302 FUNDAMENTALS OF NUCLEAR ENGINEERING

4 (3-2) S

Prerequisite: NE 301 or PY 410

An introductory course in nuclear engineering, aimed at preparing the student for further study in the field. Topics include neutron physics, reactor theory, reactor systems, radioisotope technology, other nuclear methods, shielding and radiological safety. Particular emphasis is given to the engineering aspects of nuclear systems, facilities and applications. Laboratory sessions include reactor operations, experiments and applications, radioisotopes and activation analysis applications, shielding and dosimetry.

Mr. Stam

NE 401 REACTOR ANALYSIS AND DESIGN

4 (3-2) S

Prerequisite: NE 302 or NE 419

Elements of nuclear reactor theory, including neutron cross section behavior, transport theory, neutron slowing and diffusion, Fermi age theory, multigroup concepts, criticality of homogeneous reactors, and kinetics of simple systems. Observation and measurements of static and dynamic nuclear behavior, the effectiveness of control and temperature and correlation with theory. Experiments on the motion and detection of neutrons and gamma rays, as they relate to the operation of nuclear reactors and radiation control.

Mr. Verghese

NE 402 REACTOR ENGINEERING

4 (3-2) F

Corequisite: NE 401

Engineering topics pertinent to the design and operation of reactors are stressed. These include heat transfer in flowing fluids, power-plant systems, fuel cycles, power plant economics and reactor operations. Laboratories include reactor start-up and control, reactor kinetics, reactor and power-plant heat transfer and the monitoring of radioactivity in reactor effluents.

Mr. Zumwalt

NE 403 NUCLEAR ENGINEERING DESIGN PROJECTS

2 (1-3) S

Prerequisite: NE 402

Student projects in design of practical nuclear engineering systems. The faculty of the nuclear engineering department participates in selection and direction of the projects. The use of computer codes is stressed.

Staff

NE 419 INTRODUCTION TO NUCLEAR ENGINEERING 3 (3-0) FS
Prerequisite: PY 206 or PY 208

A survey of nuclear energy applications, including nuclear reactor materials, reactor theory, shielding, thermal and hydraulic analysis, and control. Uses of nuclear fission and its by-products in research, industry and propulsion are reviewed. The major engineering problems are defined and methods of approach are outlined. This course is designed for students in other departments. Mr. Stam

NE 491, 492 NUCLEAR ENGINEERING TOPICS I, II 3 (3-0) FS
Prerequisite: NE 402

These courses are intended to provide more detailed coverage of important nuclear engineering topics such as radiation applications, nuclear fuel cycles and isotope production, reactor systems, and radiological and reactor safety. These courses provide a nucleus of special emphasis courses that may be elected by nuclear engineering seniors and professional degree students.

Messrs. Elleman, Gardner, Saxe, Verghese

FOR GRADUATES AND ADVANCED UNDERGRADUATES

NE 501 REACTOR ANALYSIS 3 (3-0) F
Prerequisites: NE 302, NE 419 or consent of instructor

Elements of nuclear reactor theory, including neutron mechanics, spatial aspects, critical mass calculations, time behavior, spectral characteristics, multigroup and multiregion descriptions, heterogeneous systems, reactivity and reactor dynamics, perturbation theory and neutron transport. Mr. Siewert

NE 502 REACTOR DESIGN 3 (3-0) S
Prerequisite: NE 501

Elements of nuclear reactor design and operation, including reactor materials, thermal and hydraulic analysis, control and safety, and thermal and fast reactor systems. Mr. Saxe

NE 504 (MA 504) MATHEMATICAL METHODS IN ENGINEERING 3 (3-0) F
(See mathematics, page 366.)

NE 505 EXPERIMENTAL METHODS IN NUCLEAR ENGINEERING 3 (1-4) S
Prerequisites: NE 501, NE 511
Corequisites: NE 502, NE 512

Laboratory experiments are performed to illustrate the principles and concepts covered in NE 501, NE 502, NE 511 and NE 512. Mr. Gardner

NE 511 (PY 511) NUCLEAR PHYSICS FOR ENGINEERS 3 (3-0) F
(See physics, page 406.)

NE 512 RADIATION APPLICATIONS 3 (3-0) S
Prerequisite: NE 511

Applications of radiation interaction principles to practical nuclear problems. Topics include radiological safety, effects of radiation on biological and structural materials, and industrial applications of radioisotopes and radiation.

NE 562 (MAT 562) MATERIALS PROBLEMS IN NUCLEAR ENGINEERING 3 (3-0) F
(See materials engineering, page 362.)

**NE 573 (MAT 573) COMPUTER EXPERIMENTS IN MATERIALS
ENGINEERING**

3 (3-0) F

Prerequisites: PY 407, MA 301

The basic techniques for constructing both statistical (Monte Carlo) and deterministic computer experiments will be explained and discussed from the standpoint of immediate use in the solution of current engineering research and development.

Mr. Beeler

NE 591, 592 SPECIAL TOPICS IN NUCLEAR ENGINEERING I, II

3 (3-0) FS

Prerequisite: Consent of instructor

FOR GRADUATES ONLY

NE 601 REACTOR THEORY AND ANALYSIS

3 (3-0)

NE 602 ADVANCED REACTOR THEORY

3 (3-0)

NE 611 RADIATION DETECTION

3 (2-2)

NE 620 NUCLEAR RADIATION ATTENUATION

3 (3-0)

NE 621 RADIATION EFFECTS ON MATERIALS

3 (3-0)

NE 622 TRANSPORT OF MATTER IN NUCLEAR REACTORS

3 (3-0)

NE 631 REACTOR KINETICS AND CONTROL

3 (3-0)

NE 641 RADIOISOTOPE APPLICATIONS

3 (3-0)

NE 653 NUCLEAR REACTOR DESIGN

3 (3-0)

NE 691, 692 ADVANCED TOPICS IN NUCLEAR ENGINEERING I, II

3 (3-0) FS

NE 695 SEMINAR IN NUCLEAR ENGINEERING

1 (1-0) FS

NE 699 RESEARCH IN NUCLEAR ENGINEERING

Credits Arranged FS

OPERATIONS RESEARCH

OR 501 INTRODUCTION TO OPERATIONS RESEARCH

3 (3-0) F Sum.

Prerequisites: MA 405, MA 421

OR Approach: Modeling, constraints, objective and criterion. The problem of multiple criteria. Optimization. Model validation. The team approach. Systems design. Examples. OR Applications: Theory of inventory: economic ordering under deterministic and stochastic demand. The production smoothing problem: linear and quadratic cost functions. Waiting line problems: single and multiple servers with Poisson input and output. The theory of games for two-person competitive situations. Project management through PERT-CPM.

Mr. Cooper

OR 505 (IE 505, MA 505) MATHEMATICAL PROGRAMMING I

3 (3-0) F Sum.

Prerequisite: MA 405

A study of mathematical methods applied to problems of planning. Linear programming will be covered in detail. This course is intended for those who desire to study this subject in depth and detail. It provides a rigorous and complete develop-

ment of the theoretical and computational aspects of this technique as well as a discussion of a number of applications. Mr. Alvarez

OR 509 (IE 509) DYNAMIC PROGRAMMING 3 (3-0) F Sum.
Prerequisites: MA 405, ST 421

An introduction to the theory and computational aspects of dynamic programming and its application to sequential decision problems. Mr. Nuttle

OR 520 THEORY OF ACTIVITY NETWORKS 3 (3-0) S
Prerequisites: OR 501, OR 505

Introduction to graph theory and network theory. A discussion in depth of the theory underlying (i) deterministic activity networks (CPM): optimal time-cost trade offs; the problem of scarce resources; (ii) probabilistic activity networks (PERT): critical evaluation of the underlying assumptions; (iii) generalized activity networks (GERT, GAN): applications of signal flow graphs and semi-Markov process to probabilistic branching; relation to the theory of scheduling.

Mr. Elmaghraby

OR 522 (IE 522) DYNAMICS OF INDUSTRIAL SYSTEMS 3 (3-0) S
(See industrial engineering, page 354.)

OR 527 (CHE 527) OPTIMIZATION OF ENGINEERING PROCESSES 3 (3-0) F
(See chemical engineering, page 259.)

OR 606 (MA 606, ST 606) MATHEMATICAL PROGRAMMING II 3 (3-0) S

OR 609 (IE 609) ADVANCED DYNAMIC PROGRAMMING 3 (3-0) F

OR 621 (IE 621) INVENTORY CONTROL METHODS I 3 (3-0) S

OR 631, 632 (EM 631, 632) VARIATIONAL METHODS IN OPTIMIZATION
TECHNIQUES I, II 3 (3-0) F S

OR 691 SPECIAL TOPICS IN OPERATIONS RESEARCH 3 (3-0) F S Sum.

OR 692 (IE 692, MA 692) SPECIAL TOPICS IN MATHEMATICAL
PROGRAMMING 3 (3-0) FS Sum.

OR 695 SEMINAR IN OPERATIONS RESEARCH 1 (1-0) F S

OR 699 PROJECT IN OPERATIONS RESEARCH 1-3 F S Sum.

PHILOSOPHY

(Also see Religion)

FOR UNDERGRADUATES

PHI 201 LOGIC 3 (3-0) F S

This is a basic course covering the nature and evaluation of logical discourse, both deductive and inductive. Deductive topics include aspects of traditional term

logic as well as an elementary introduction to contemporary symbolic logic. Inductive topics include probability, generalization, analogy and hypothesis.

Messrs. Kurylo, Metzgar, O'Neil

PHI 205 PROBLEMS AND TYPES OF PHILOSOPHY 3 (3-0) F S

This is an introductory course, and the matters discussed will always be those with a history of importance in philosophy, such as problems concerning God, freedom, justice, and the nature and objects of human knowledge.

Messrs. Bryan, Bredenberg, Fitzgerald, O'Neil, Regan, Van De Veer

PHI 300 EARLY WESTERN PHILOSOPHY 3 (3-0) F

This course traces the philosophical movements of western civilization from the pre-socratics of ancient Greece, in whom western philosophy had its origins, to the scientific revolution of the 17th century. The course will especially emphasize the works of Plato and Aristotle.

PHI 301 MODERN WESTERN PHILOSOPHY 3 (3-0) S

This course consists of a critical survey of selected works of the major western philosophers from the 17th century to the 20th century. This course will examine the works of such philosophers as Descartes, Spinoza, Locke, Hume, Hegel and Kant, and will include an adumbration of the trends taken by philosophy in the 20th century.

PHI 304 (ED 304) PHILOSOPHY OF EDUCATION 3 (3-0) F S

This course is designed to assist students in understanding the relationship between philosophy and education and in developing and clarifying their own philosophy of education. Course activities include the review of patterns of thought that have given direction to educational aims and values and an analysis of selected issues and problems in contemporary American education. Messrs. Bryan, Middleton

PHI 305 PHILOSOPHY OF RELIGION 3 (3-0) F S

This course is designed as a conceptual analysis and phenomenological inquiry into (a) the nature of religion, (b) religious language, (c) the religious experience, and (d) such key concepts as God, creation, evil, faith, symbols, myth and immortality.

PHI 306 PHILOSOPHY OF ART 3 (3-0) F S

The general course objective is to analyze concepts and theories encountered in discussions of art in such a way as to illuminate the nature of works of art, esthetic experiences, and art criticism. Special attention is given to such concepts as creation, expression, intention, interpretation, communication and evaluation, and to the problems and fallacies which seem to be involved in the use of these concepts.

Mr. Bredenberg

PHI 307 MORALITY AND HUMAN HAPPINESS 3 (3-0) F

Moral philosophers attempt to articulate, clarify and justify their beliefs about values and obligations. Accordingly, they have sought to answer such questions as the following: What things are ultimately good? How can we determine what our moral obligations are? How do the demands of morality promote or retard the individual's quest for happiness and self-fulfillment? The works of both classical and contemporary moral philosophers are used as a basis for discussing these and related questions.

Mr. Regan

PHI 308 CONTEMPORARY MORAL PHILOSOPHY**3 (3-0) S**

Many 20th century philosophers have argued that man cannot presume to have moral knowledge—knowledge of what is right or wrong, good or bad. On what do they base their claims? Are their arguments justified, and if so, how can it be rational for a person to behave in the manner he deems to be moral? These and kindred questions are discussed in the course of examining some of the leading figures of 20th century American, English and French thought.

Mr. Regan**PHI 310 EXISTENTIALISM****3 (3-0) F S**

Existentialism is a major type of recent philosophy which has greatly influenced contemporary art, literature and religion. This course traces the central existentialist motifs in the work of Kierkegaard, Nietzsche, Heidegger, Sartre, and others, and shows their influence upon contemporary culture.

Mr. Fitzgerald**PHI 317 PHILOSOPHY FROM DESCARTES THROUGH HUME****3 (3-0) F**

What is the nature of reality? Is everything that exists material, immaterial, or do both types of thing exist? How can we know? What is human knowledge and how is it acquired? The philosophers of this period offer conflicting answers to one or another of these questions, each providing a detailed statement of alternative views concerning the origin and extent of human knowledge and the nature of reality. Those included in the survey are Descartes, Leibniz, Spinoza, Locke, Berkeley and Hume.

PHI 318 PHILOSOPHY FROM KANT TO THE PRESENT**3 (3-0) S**

Prerequisite: PHI 317 or consent of department

In spite of the variety and individuality of the philosophic thought from Kant to the present, the influence of Kant can be discerned in many directions. Depending on what they accepted in his philosophy, German idealists like Hegel and Schopenhauer take one general direction. The Logical Positivists, G. E. Moore and Bertrand Russell, take another. This course traces and explores some of the important roads leading from Kant.

PHI 325 20TH CENTURY ANALYTIC PHILOSOPHY**3 (3-0) F S**

Some 20th century philosophers have dared to speak of a "revolution in philosophy", maintaining that a rigorous use of conceptual or linguistic analysis reveals inadequacies in all previous philosophical theories and methods. This course is concerned with exploring the nature of such analysis and discovering whether it can in fact resolve all the perennial problems of philosophy. Accordingly, studies are done in the work of such philosophers as Russell, Moore, Wittgenstein, Ayer, Malcolm, Strawson and Austin.

PHI 401 SYMBOLIC LOGIC**3 (3-0) F S**

This course is an introduction to symbolic logic and examines propositional logics, including the rudiments of multivalued and modal logics, first order general predicate logic, identity and description, and selected elements of meta-theory.

Messrs. Kurylo, Metzgar**PHI 405 PHILOSOPHY OF SCIENCE****3 (3-0) F S**

This course is concerned with the character and function of "explanation" in scientific activity. It examines the concepts of "law" and "theory" and seeks to establish the kind of claims to knowledge that scientific activity is entitled to advance. The role of inductive confirmation is examined, and the relationship between natural and social science explored.

Mr. Metzgar

PHI 406 CONTEMPORARY POLITICAL PHILOSOPHY**3 (3-0) F S**

The course will focus on current discussions of basic concepts in political philosophy (such as liberty, equality, justice, natural rights, democracy) with the aim of clarifying and resolving disputes concerning the relation of the individual to the state, the possibility of a tyranny of the majority in a democracy, and the use and justification of moral principles in political philosophy.

Mr. Van De Veer**PHI 407 THEORY OF KNOWLEDGE****3 (3-0) F**

Course objectives include analysis of the meaning of such central concepts as knowledge, belief and truth, of the main kinds of knowledge, and of the principles by which claims to know may be justified. Special attention is given to the problems involved in our claims to knowledge of the world through the evidence of the senses.

Messrs. Bredenberg, Bryan**PHI 490, 491 SEMINARS IN PHILOSOPHY****3 (3-0) F S**

Prerequisite: Six hours of philosophy

The seminars are devoted to special studies in contemporary philosophy, with emphasis on research and critical analysis. Students entering the seminars are expected to be familiar with the major doctrines of modern western philosophy.

PHI 492 PHILOSOPHY SEMINARS ON THE HUMAN CONDITION**3 (3-0) F S**

These seminars will be directed not only to scrutinizing in a philosophical way the so-called "Big Issues" like violence, civil disobedience, capital punishment, poverty, abortion and euthanasia, automation and cybernetics, and the quality of the environment; but also to exploring in a philosophical way the myriad dimensions and delicate subtleties of human experience like humor, eccentricity, fear, national differences, toleration, pornography, drugs, nostalgia. Each seminar will consider a natural cluster of such topics.

PHI 498 SPECIAL TOPICS IN PHILOSOPHY**1-6 F S**

Prerequisite: Six hours philosophy

This course has no fixed description and is used to offer areas of study which appear only rarely in the curriculum and will also function as a readings course for honors students in philosophy.

PHI 499 SENIOR ESSAY IN PHILOSOPHY**3 F S**

Prerequisite: Consent of department

The course work consists of individually directed research on a topic chosen in consultation with a staff adviser. The objective is a critical, written analysis of a well-defined topic in the thought of a major philosopher or in the literature on one of the main problems of philosophy.

PHI 590 (EM 590, REL 590) TECHNOLOGY AND HUMAN VALUES**3 (3-0) F S**

(See engineering mechanics, page 308.).

PHYSICAL AND MATHEMATICAL SCIENCES FOR UNDERGRADUATES

PSM 100 ORIENTATION**0 (1-0) F**

Introduction to the field of the physical sciences and mathematics.

Staff

PHYSICAL EDUCATION

PRESCRIBED COURSES

PE 100 HEALTH AND PHYSICAL FITNESS 1 (0-2) F

A lecture laboratory course designed to assess and improve the individual's physical fitness; and to convey essential health/fitness knowledge related to the activity continuum.

PE 112 BEGINNING SWIMMING I 1 (0-2) F S

A course for nonswimmers which is designed for meeting the University swimming requirements.

PE 113 BEGINNING SWIMMING II 1 (0-2) F S

A course for very weak swimmers. It is designed for meeting the University swimming requirement (and for preparing the student to take the intermediate swimming course).

PE 118 RESTRICTED ACTIVITY I 1 (0-2) F S

A course designed specifically to meet the needs of those individuals who have temporary or permanent physical impairments. Students entering this program must obtain a restrictive form from the Student Health Service.

PE 119 RESTRICTIVE ACTIVITY II 1 (0-2) F S

Prerequisite: PE 118

This course is a follow-up of PE 118.

CONTROLLED ELECTIVE COURSES

AQUATICS

PE 221 INTERMEDIATE SWIMMING 1 (0-2) F S

A course designed to give the student competence in four basic strokes and two dives.

PE 222 WATER SPORTS 1 (0-2) S

A course to teach the skills of water polo and water basketball, plus improvement in stamina and water skills.

PE 223 SENIOR LIFE SAVING 1 (0-2) F S

Prerequisite: PE 221 or equivalent

A course designed to qualify students for a Senior Red Cross Life Saving certificate.

PE 224 WATER SAFETY INSTRUCTORS 1 (0-2) F S

Prerequisite: PE 223 or equivalent

A course designed to qualify students for a Red Cross Water Safety Instructor's rating.

COMBATIVES

PE 232 PERSONAL DEFENSE 1 (0-2) F S
Prerequisite: PE 231 or equivalent

To promote mastery of fear that may arise from the anticipation of violent personal contact and to equip students with the techniques for personal defense. To include falls, throws, counters, locks, escapes.

PE 233 BOXING 1 (0-2) F S

A course designed to acquaint the student with the fundamentals, skills, history and rules, with special emphasis on defensive techniques.

PE 238 WRESTLING 1 (0-2) F S

A course designed to teach the fundamental skills, history and rules of wrestling and the values of regular exercise.

DEVELOPMENTAL ACTIVITIES

PE 117 GYMNASTICS I 1 (0-2) F S

A course designed for teaching the fundamentals of gymnastics on the parallel bars, side horse, trampoline and mats.

PE 231 BODY MECHANICS I (WOMEN) 1 (0-2) F S

A course designed to direct the student in a program of physical development and coordinated movement.

PE 234 GYMNASTICS II 1 (0-2) F S

Prerequisite: PE 117 or equivalent

This course is a follow-up of PE 117 with a primary emphasis on leadership training.

PE 236 TRACK AND FIELD 1 (0-2) F S

A course designed to develop knowledge, skill and interest in track and field events.

PE 237 WEIGHT TRAINING 1 (0-2) F S

A course designed for teaching the basic skills of body development through weight training. The student should gain knowledge of the principles of strength development and improve himself physically.

PE 239 MODERN DANCE (WOMEN) 1 (0-2) F S

A course designed for each student to gain knowledge, skill and application of modern dance. It emphasizes the basic fundamentals of body movement executed to music.

INDIVIDUAL SPORTS

PE 241 ANGLING 1 (0-2) F S

A course designed to teach the fundamental skills of spin, fly and bait casting and an understanding of game fishing.

PE 242 BADMINTON 1 (0-2) F S

A course designed to give the beginner skill in the basic strokes and a general knowledge of the history, rules and strategy of the game.

PE 243 BOWLING 1 (0-2) F S

The fundamentals of ball selection, grips, stance and delivery are taught along with rules, history, scoring and the general theory of spare coverage.

PE 244 FENCING 1 (0-2) F S

A course designed to teach the basic fundamentals, skills, techniques and rules of fencing.

PE 245 GOLF 1 (0-2) F S

A course designed for teaching beginners the grip, stance, swing and use of the various clubs, along with the history and etiquette of play.

PE 246 HANDBALL 1 (0-2) F S

A course designed to include the fundamental skills, together with the history and rules of handball.

PE 247 ROLLER SKATING 1 (0-2) F S

A course designed to teach the fundamental skills of roller skating, with the emphasis on balance and speed.

PE 248 SQUASH 1 (0-2) F S

A course designed to include the fundamental skills, together with the history and rules of squash.

PE 249 TENNIS I 1 (0-2) F S

A course designed to give beginners a thorough knowledge of the history, rules and strategy as well as the fundamental skills of tennis.

PE 250 TENNIS II 1 (0-2) F S

Prerequisite: PE 249 or equivalent

This course is a follow-up of PE 249 with emphasis on game strategy and doubles play.

PE 251 TARGET ARCHERY 1 (0-2) F S

A course designed to teach the fundamental skills of target archery and the selection and care of archery equipment.

TEAM SPORTS

PE 116 SOCCER 1 (0-2) F

A course designed to acquaint the student with the fundamental skill of the game and to offer the values of a vigorous outdoor team sport.

PE 261 BASKETBALL 1 (0-2) F S

A course designed to teach the history, rules and strategy as well as the fundamental skills of basketball.

PE 262 BASKETBALL (WOMEN) 1 (0-2) F S

A course designed to teach girls the history, rules and strategy as well as the fundamental skills of basketball.

- PE 263 FIELD HOCKEY (WOMEN)** 1 (0-2) S
 A course designed to teach girls the history, rules and strategy as well as the fundamental skills of field hockey.
- PE 264 SOCCER (WOMEN)** 1 (0-2) F
 A course designed to teach girls the history, rules, and strategy as well as the fundamental skills of soccer.
- PE 265 SOFTBALL** 1 (0-2) S
 A course designed to include the fundamental skills, history and rules of the game.
- PE 267 TOUCH FOOTBALL** 1 (0-2) F
 A course designed to include the fundamental skills, history, rules and strategy of touch football.
- PE 268 TOUCH FOOTBALL (WOMEN)** 1 (0-2) F
 A course designed to teach girls the fundamental skills, history, rules and strategy of the game.
- PE 269 VOLLEYBALL** 1 (0-2) F S
 A course designed to include the fundamental skills, history, rules and strategy of the game.

VARSITY SPORTS

- PE 271 VARSITY SPORTS I** 1 (0-2) F S
 This course is for students who are transferring to a varsity sport for a term (eight weeks) for the first time.
- PE 272 VARSITY SPORTS II** 1 (0-2) F S
 This course is for students who are making their second transfer to a varsity sport.
- PE 273 VARSITY SPORTS III** 1 (0-2) F S
 This course is for sophomores or those students who have received credit for two semesters of physical education and are transferring to a varsity sport.
- PE 274 VARSITY SPORTS IV** 1 (0-2) F S
 This course is for sophomores or those students who have received credit for two semesters of physical education and are making their second transfer as a sophomore.

PHYSICAL OCEANOGRAPHY

FOR GRADUATES AND ADVANCED UNDERGRADUATES

- OY 487 (CE 487, MAS 487) PHYSICAL OCEANOGRAPHY** 3 (3-0) S
 Prerequisites: MA 202, PY 212

An introduction, on an advanced level, to the principles of physical oceanography. Subjects to be covered are: history of physical oceanography; the geological and astronomical background for the field; tides and waves; fluid mechanics; char-

acteristics of sea water; advective and convective processes; current measurements; laboratory models; and specific problems in physical oceanography.

OY 541 (MAS 541, CE 541) GRAVITY WAVE THEORY I 3 (3-0) S
(See marine sciences, page 358.)

OY 551 (MAS 551) OCEAN CIRCULATION 3 (3-0) S
(See marine sciences, page 358.)

FOR GRADUATES ONLY

OY 601 (MAS 601) ADVANCED PHYSICAL OCEANOGRAPHY I 3 (3-0) F

OY 602 (MAS 602) ADVANCED PHYSICAL OCEANOGRAPHY II 3 (3-0) S

OY 605 (MAS 605, EM 605) ADVANCED GEOPHYSICAL FLUID MECHANICS I 3 (3-0) F

OY 606 (MAS 606, EM 606) ADVANCED GEOPHYSICAL FLUID MECHANICS II 3 (3-0) S

OY 613 (MAS 613, EM 613) PERTURBATION METHOD IN FLUID MECHANICS I 3 (3-0) F

OY 614 (MAS 614, EM 614) PERTURBATION METHOD IN FLUID MECHANICS II 3 (3-0) S

PHYSICS

FOR UNDERGRADUATES

PY 205, 206, 207 GENERAL PHYSICS 4 (3-3) FS
Corequisite: MA 201

This sequence is intended primarily for majors in the departments of the School of Physical and Mathematical Sciences and the Department of Nuclear Engineering. Calculus is used throughout as needed. These courses are intended to give a good foundation for further study in the physical sciences. Staff

PY 205, 208 GENERAL PHYSICS 4 (3-3) FS
Corequisite: MA 201

This sequence is required in most engineering curricula. A study of classical and modern physics in which the analytical approach is employed and calculus is applied as needed. Demonstration lectures, recitations, problem drill and laboratory work are coordinated to give a working knowledge of basic principles. PY 205, mechanics, sound and heat; PY 208, electricity, light and modern physics. Staff

PY 211, 212 GENERAL PHYSICS 4 (3-2) FS
Prerequisite: MA 111 or MA 116

These courses are designed for curricula requiring a basic though not specialized knowledge of physics. Lecture-demonstration, recitation and laboratory are coordinated to give a working familiarity with basic principles of mechanics, heat, sound, light, electricity and modern physics. Staff

PY 221 COLLEGE PHYSICS**5 (5-0) FS****Prerequisite: MA 111**

An introduction to the fundamental principles of physics and the many applications to modern science and technology. The important concepts in the classical areas of physics are presented, along with a brief survey of modern atomic physics. Lectures and demonstrations with class participation. Staff

PY 223 ASTRONOMY AND ASTROPHYSICS**3 (3-0) S****Prerequisite: PY 212 or PY 208**

A survey course at the introductory level. The development of astronomical thought is reviewed, followed by a study of the solar system, stellar evolution and current cosmological theories. Observational methods and techniques of measurement are taught along with a review of the underlying physical principles.

Mr. Bowman

PY 231 FOUNDATIONS OF PHYSICS**5 (5-0) FS****Prerequisite: MA 111 or MA 115**

A one-semester survey course concerned with the philosophy, the methods and the fundamental concepts of physics. The student will be introduced to Newtonian particle mechanics, conservation concepts, kinetic theory of matter, thermodynamics, wave phenomena, electricity and magnetism, principles of relativity, quantum concepts, and some atomic and nuclear phenomena.

Mr. Owen

FOR ADVANCED UNDERGRADUATES**PY 401, 402 MODERN AND QUANTUM PHYSICS I, II****3 (3-0) FS****Prerequisite: PY 411**

Topics will include special relativity, the origin of quantum theory, elementary quantum mechanics, atomic structure and optical spectra, x-rays and fundamental particles.

Mr. Patty

PY 407 INTRODUCTION TO MODERN PHYSICS**3 (3-0) FS****Prerequisites: MA 202, PY 208**

A survey of the important developments in atomic and nuclear physics of this century. Among topics covered are: an introduction to special relativity, atomic and molecular structure, determination of properties of ions and fundamental particles, the origin of spectra, and nuclear reactions.

Staff

PY 409 ION AND ELECTRON PHYSICS**3 (2-3) S****Prerequisite: PY 414**

Topics covered include collision processes in gases, electron emission, charged particle dynamics, gaseous discharges, and the physics of electron and ion beams.

Mr. Bennett

PY 410 NUCLEAR PHYSICS I**4 (3-2) FS****Prerequisite: PY 207 or PY 407**

An introduction to the properties of the nucleus, with emphasis on the concepts necessary for an understanding of nuclear structure. Nuclear reactions, alpha, beta, and gamma decay, fission and fusion are treated quantitatively. The interaction of nuclear radiation with matter as it bears on detection devices is discussed.

Mr. Tilley

PY 411, 412 MECHANICS I, II**3 (3-0) FS****Prerequisites: MA 301, PY 207 or PY 208**

A sequence of courses in intermediate theoretical mechanics, including the

dynamics of particles and rigid bodies, and the mechanics of continuous media. An introduction is given to advanced mechanics, including Lagrange's equations of motion, with applications. Mr. Moss

PY 413 THERMAL PHYSICS 3 (3-0) S
Prerequisite: PY 206 or PY 208
Corequisite: MA 301

An intermediate course in the principles of classical thermodynamics and the kinetic theory of gases with an introduction to statistical mechanics. Mr. Lynn

PY 414, 415 ELECTRICITY AND MAGNETISM I, II 3 (3-0) FS
Prerequisite: PY 207 or PY 208
Corequisite: MA 511

An intermediate course in the fundamentals of static and dynamic electricity and electromagnetic theory, developed from basic experimental laws. Vector methods are introduced and employed throughout the course. Mr. Lado

PY 416 PHYSICAL OPTICS 3 (2-2) S
Prerequisite: PY 415

An intermediate course in physical optics with the major emphasis on the wave properties of light. Subjects covered include boundary conditions, optics of thin films, interference, diffraction and the Lorentz atom with applications to absorption, scattering and laser emission. Mr. Doggett

PY 443 ASTROPHYSICS 3 (3-0) S
Prerequisites: PY 207 or PY 407; PY 411

A survey of the basic physics necessary to investigate, from observational data, the internal conditions of stars, and their evolution. Topics to be considered will include the formation and structure of spectral lines, methods of energy generation and transport, stellar structure, degeneracy and white dwarfs. Mr. Danby

PY 451, 452 INTERMEDIATE EXPERIMENTS IN PHYSICS I, II 2 (1-3) FS
Corequisites: PY 411, PY 414

Experiments at the intermediate level in mechanics, electricity and magnetism, and modern physics. Mr. Martin

PY 499 SPECIAL PROBLEMS IN PHYSICS 1-3 FS
Prerequisite: Consent of department

Study and research in special topics of classical and modern physics. A topic may be chosen for experimental or theoretical investigation, or a literature survey may be made. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PY 501, 502 INTRODUCTION TO QUANTUM MECHANICS I, II 3 (3-0) FS
Prerequisites: MA 511; PY 411 or PY 414

An introduction to the fundamental concepts and techniques of quantum mechanics, and the application of the theory to simple physical systems, such as the free particle, the harmonic oscillator, potential well and central force problems. Other topics include spin, transformation theory, identical particles, symmetry and invariance, approximation methods, and an introduction to the quantum theory of angular momentum. Mr. Memory

PY 503, 504 INTRODUCTION TO THEORETICAL PHYSICS I, II 3 (3-0) FS
Prerequisites: MA 511, PY 412, PY 414

An introductory course in theoretical physics which offers preparation for graduate study. Emphasis is on classical mechanics and special relativity. Topics covered include variational principles, Hamiltonian dynamics and the canonical transformation theory, structure of the Lorentz group, and elementary dynamics of unquantized fields. Mr. Katzin

PY 507 ADVANCED ATOMIC PHYSICS 3 (3-0) F
Prerequisites: MA 511, PY 412, PY 415

An introduction to the quantum mechanical treatment of atomic structure and spectra. Topics covered include the relativistic hydrogen atom, the helium atom, multielectron atoms, selection rules, etc. Mr. Chung

PY 509 PLASMA PHYSICS 3 (3-0) F
Prerequisite: PY 414

A study of the individual and collective motion of charged particles in electric and magnetic fields and through ionized gases, including the pinch effect and induced processes in relativistic streams; transport equations; and properties of plasmas, including wave production and propagation, instabilities, shocks and radiation losses, with applications. Mr. Bennett

PY 510 NUCLEAR PHYSICS II 4 (3-2) F
Prerequisite: PY 410

A study of the properties of the atomic nucleus as revealed by radioactivity, nuclear reactions and scattering experiments, with emphasis on the experimental approach. The laboratory is designed to stimulate independent research and offers project work in nuclear spectroscopy and in neutron physics. Mr. Waltner

PY 511 (NE 511) NUCLEAR PHYSICS FOR ENGINEERS 3 (3-0) F
Prerequisite: PY 410

A study of the properties of atomic nuclei, of nuclear radiations and of the interaction of nuclear radiation with matter. Emphasis is placed on the principles of modern equipment and techniques of nuclear measurement and their application to practical problems. Mr. Waltner

PY 514, 515 ADVANCED ELECTRICITY AND MAGNETISM I, II 3 (3-0) FS
Prerequisite: PY 415

An advanced treatment of electricity and magnetism and electromagnetic theory. Topics include: techniques for the solution of potential problems, development of Maxwell's equations; wave equations; energy, force and momentum relations of an electromagnetic field; covariant formulation of electrodynamics; radiation from accelerated charges. Mr. Jenkins

PY 517 MOLECULAR SPECTRA 3 (3-0) S
Prerequisites: PY 407, PY 412; PY 507 recommended

Topics include the interpretation of infrared and Raman spectra for diatomic and simple polyatomic molecules; the effects due to vibration-rotation interaction, electronic motion and nuclear spin; nuclear magnetic resonance spectroscopy; infrared absorption in the earth's atmosphere. Mr. Chung

PY 520 MEASUREMENTS IN NUCLEAR PHYSICS 3 (2-2) S
Prerequisite: PY 410

A study of the fundamentals of statistics (including the binomial, normal, Poisson and interval distributions) as applied to the analysis of measurements on nuclear reactions and radioactivity. Mr. Waltner

PY 521 KINETIC THEORY OF GASES 3 (3-0) F
Prerequisite: PY 413

A study of the transport properties of classical gases centering on the Boltzmann equation and its consequences. Topics covered include the phenomena of diffusion, viscosity and heat conduction, and the derivation of the equations of hydrodynamics.
Mr. Ridgeway

PY 552 INTRODUCTION TO THE STRUCTURE OF SOLIDS 3 (3-0) S

Prerequisite: PY 207 or PY 407

Corequisite: PY 501

Basic considerations of crystalline solids, metals, conductors and semiconductors.
Mr. Schetzina

PY 555 (MA 555) MATHEMATICAL INTRODUCTION TO CELESTIAL MECHANICS 3 (3-0) F

(See mathematics, page 368.)

PY 556 (MA 556) ORBITAL MECHANICS 3 (3-0) F

(See mathematics, page 368.)

PY 599 SENIOR RESEARCH 3 FS

Prerequisite: Senior honors program standing, except with special permission

Investigations in physics which may consist of literature reviews, experimental measurements or theoretical studies.
Graduate Staff

FOR GRADUATES ONLY

PY 600 PLANETARY ATMOSPHERES 3 (3-0) S

PY 601, 602 THEORETICAL PHYSICS I, II 3 (3-0) FS

PY 609 HIGH ENERGY PHYSICS 3 (3-0) S

PY 610 ADVANCED NUCLEAR PHYSICS 3 (3-0) F

PY 611 QUANTUM MECHANICS 3 (3-0) F

PY 612 ADVANCED QUANTUM MECHANICS 3 (3-0) S

PY 622 STATISTICAL MECHANICS 3 (3-0) S

PY 630, 631 NUCLEAR STRUCTURE PHYSICS I, II 3 (3-0) FS

PY 641 NON-INERTIAL SPACE MECHANICS 3 (3-0) S

PY 651 MATHEMATICS OF SOLID-STATE AND MANY-BODY THEORY 3 (3-0) F

PY 652 COOPERATIVE PHENOMENA IN SOLIDS 3 (3-0) S

PY 655 (MA 655) QUALITATIVE METHODS IN CELESTIAL MECHANICS 3 (3-0) F

PY 656 (MA 656) PERTURBATION THEORY IN CELESTIAL MECHANICS 3 (3-0) S

PY 690 SPECIAL TOPICS IN MOLECULAR PHYSICS 1-6 FS

PY 691 SPECIAL TOPICS IN NUCLEAR PHYSICS 1-6 FS

PY 692	SPECIAL TOPICS IN PLASMA PHYSICS	1-6 FS
PY 693	SPECIAL TOPICS IN SOLID STATE PHYSICS	1-6 FS
PY 694	SPECIAL TOPICS IN THEORETICAL PHYSICS	1-6 FS
PY 695	SEMINAR	1 (1-0) FS
PY 699	RESEARCH	Credits Arranged

PLANT PATHOLOGY

FOR UNDERGRADUATES

PP 315	PLANT DISEASES	3 (2-3) F
Prerequisite: BS 100		

The nature and symptoms of disease in plants and the characteristics of important plant pathogenic nematodes, viruses, bacteria and fungi are studied. An understanding of the important concepts and methods of disease control is developed, based on a knowledge of major types of plant diseases. Messrs. Beute, Powell

PP 318 (FOR 318)	FOREST PATHOLOGY	3 (2-3) S
Prerequisite: BS 100 or equivalent		

The major types of diseases of forest trees and deterioration of wood products are studied with emphasis on: 1) economic impact on forest resources; 2) symptomatology and diagnosis; 3) nature of pathogens and saprophytic microorganisms; 4) physiology, ecology and dissemination of causal organisms; 5) mechanisms of pathogenesis; 6) epidemiology and environmental influences; 7) principles of prevention and control. Messrs. Cowling, Grand

PP 319 (WPS 319)	BIOLOGICAL DETERIORATION OF WOOD	1 (2-3) S
Prerequisite: BS 100 or equivalent		

Biological deterioration of wood and its control are studied with emphasis on: 1) impact of various types of deterioration on economic values of wood products and on processes of wood utilization; 2) diagnosis of deterioration problems; 3) nature of the biological influences and microorganisms involved; 4) physiology of wood-inhabiting fungi and bacteria; 5) environmental influences on rates and type of deterioration; 6) prevention and control of deterioration of wood under various conditions of storage and use. Messrs. Cowling, Grand

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PP 500	PLANT DISEASE CONTROL	3 (2-3) S
Prerequisite: PP 315		

Disease control strategies and tactics are developed in a practical manner. Control economics and practices are considered in relation to principles and current research on biological, cultural, physical and chemical methods. Disease resistance and regulatory methods are also discussed. Messrs. Jenkins, Spurr

PP 501	PHYTOPATHOLOGICAL METHODS	4 (2-6) F
Prerequisites: PP 315, consent of instructor		

A study of the principles of phytopathological research. The course is designed to apply the classical scientific method to the investigation of plant diseases. Consideration will be given to appraising disease problems, reviewing the literature, isolat-

ing pathogens, inoculating with pathogens, measuring and controlling environment, histopathological studies, collecting and evaluating data, and manuscript preparation.
Messrs. Cowling, Main, Sherwood

PP 502 PHYTOPATHOLOGICAL PRINCIPLES 4 (3-3) S
Prerequisites: PP 315, consent of instructor

A study of general principles of plant pathology including in-depth study of selected diseases. The basic concepts of etiology, pathology, epidemiology and control will be considered.
Mr. Powell

PP 503 IDENTIFICATION OF PLANT PATHOGENIC FUNGI 3 (4-12) Sum.
Prerequisite: Mycology or one advanced course in plant pathology

A study of the recognition and identification of fungi which cause plant diseases and the differentiation of fungal diseases from those caused by other agents. Special consideration will be given to use of keys in the identification of fungi and the major sources of descriptive information on plant pathogens. (Offered summer, 1972 and alternate years.)
Mr. Hodges

PP 545 PLANT VIRUSES 2 (1-3) S
Prerequisite: PP 501 or equivalent

Development of the concept of viruses as plant pathogens, nature and properties of viruses, symptomatology, methods of transmission, identification, introduction to purification procedures, antiserum production, serological tests, epidemiology and control.
Mr. Gooding

PP 550 NEMATODE DISEASES OF PLANTS AND THEIR CONTROL 2 (1-3) F
Prerequisite: PP 315 or equivalent

A study of plant diseases caused by nematodes. Special consideration will be given to host-parasite relationships, host ranges and life cycles of the more important economic species. Principles and methods of control will be emphasized.
Mr. Sasser

PP 575 (BO 575, MB 575) THE FUNGI 3 (3-0) S
(See botany, page 256.)

PP 576 (BO 576, MB 576) THE FUNGI LAB 1 (0-3) S
(See botany, page 256.)

PP 595 SPECIAL PROBLEMS IN PLANT PATHOLOGY Credits Arranged Maximum 6
Prerequisite: Consent of instructor

Investigation of special problems in plant pathology not related to a thesis problem. The investigation may consist of original research and/or literature survey.
Staff

FOR GRADUATES ONLY

PP 604 MORPHOLOGY AND TAXONOMY OF NEMATODES 3 (1-6) S

PP 605 PLANT VIROLOGY 3 (1-6) F

PP 608 HISTORY OF PHYTOPATHOLOGY 1 (1-0) F

PP 609 CURRENT PHYTOPATHOLOGICAL RESEARCH UNDER FIELD CONDITIONS 2 (1-3) S

PP 611 ADVANCED PLANT NEMATOLOGY 3 (2-3) S

PP 612	PLANT PATHOGENESIS	3 (2-3) F
PP 614	NEMATODE DEVELOPMENT, CYTOLOGY AND GENETICS	2 (1-3) F
PP 625 (BO 625)	ADVANCED MYCOLOGY	4 (2-6) F
PP 650	COLLOQUIUM IN PLANT PATHOLOGY	3 (3-0) F
PP 690	SEMINAR IN PLANT PATHOLOGY	1 (1-0) FS
PP 699	RESEARCH IN PLANT PATHOLOGY	Credits Arranged

Advanced courses in Mycology are also available at UNC-Chapel Hill.

POLITICS

FOR UNDERGRADUATES

PS 200	INTRODUCTION TO POLITICS	3 (3-0) F S
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An introduction survey of the body of existing knowledge about politics and political systems, including the theories and characteristics of political behavior and political institutions within and among nation-states.

PS 201	THE AMERICAN GOVERNMENTAL SYSTEM	3 (3-0) F S
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A study of the American federal system, integrating national and state government, with emphasis on constitutional principles, major governmental organs, governmental functions, and the politics and machinery of elections. Some attention is given to other types of political systems, and comparisons are made where relevant throughout the course.

Staff

PS 206	LOCAL GOVERNMENTAL SYSTEMS	3 (3-0) F S
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An introductory study of governmental systems in the U. S. which have a primarily local focus. In addition to the examination of traditional local forms—city, county, town, township and district—attention will be given to the national, state and regional contexts for local government. Topics will include federalism and intergovernmental relations, governmental structures, political processes and political power, urbanization and problems of social and technological change, and approaches to reform.

PS 222	INTRODUCTION TO GLOBAL POLITICS	3 (3-0) F S
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This introduction to politics in the global arena examines roles and behaviors of nation-states and of nonstate actors such as individual decision-makers, interest groups, national minorities, revolutionary groups, international organizations, alliances, and multinational businesses. Major concerns include causes of international conflict, ways of resolving them, and evaluation of theories of peace and international cooperation. Some current problem areas will be analyzed, and consideration given to some alternative futures of our global system.

PS 301	MODERN POLITICAL SYSTEMS: EUROPE	3 (3-0) F
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A comparative analysis of the structure and processes of politics in the United Kingdom, France and Germany.

PS 302	MODERN POLITICAL SYSTEMS: ASIA	3 (3-0) S
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A comparative analysis of the structure and processes of politics in Japan and Communist and Nationalist China.

PS 321 U. S. FOREIGN POLICY**3 (3-0) F**

This course examines the determinants of American foreign policy and the economic, military, strategic and psychological factors conditioning that policy. Emphasis is placed on the formulation of policy, including the roles of the Executive, Congress and public opinion, and on problems of content and execution.

PS 322 INTERNATIONAL RELATIONS**3 (3-0) F**

A study of the patterns of international life, the controls upon international behavior, including the development of the United Nations and the major problems in international relations since World War II. Attention is given to the national interests and foreign policies of the states belonging to the Western and Soviet blocs, with emphasis on the positions of the United States and the Soviet Union, and to the development and impact of the newly emerging nations.

PS 376 LATIN AMERICAN GOVERNMENT AND POLITICS**3 (3-0) S**

An analysis of Latin American governmental structures, political parties and ideologies, with emphasis on the period since 1910. Social revolution, nationalism and relations with the United States will be stressed within the Latin American political context.

PS 401 AMERICAN PARTIES AND PRESSURE GROUPS**3 (3-0) F**

An analysis of political parties and interest groups as instruments for shaping public policy and implementing democratic values. Political parties and interest groups are considered as variables in the larger American system within which they exist. Attention focuses on the nature of their organization, their membership and leadership recruitment process, and their problems in aggregating votes. Attention will also be given to such topics as political style—the relationship between major and minor parties and the differences between the major parties.

PS 403 BLACK AMERICANS IN AMERICAN POLITICS**3 (3-0) F S**

Prerequisite: Six hours social studies

The study of the political activity of the Afro-American. The sources of and the kinds of attitudes he brings into the American political system; the contrast in political activity engaged in by different black groups and reasons for the differences; the impact of the black's efforts on policymaking institutions such as city councils, legislatures and executive branches of government at the state and national level.

PS 404 BLACK POLITICAL IDEOLOGY**3 (3-0) F S**

Prerequisite: Six hours social science

The study of the political thought of Black and non-Black political thinkers on the problems, struggle and movement of the Afro-Americans. Black political ideology will be related to the Afro-American movement for social change and it will be placed into the mainstream of traditional and modern political philosophy.

PS 406 POLITICS AND POLICIES OF AMERICAN STATE GOVERNMENTS**3 (3-0) S**

The course is a comparative study of the politics and policies of the 50 states. The focus is on cultural, socio-economic and political variations and state response to intergovernmental domestic programs. Attention is given to the analysis of state efforts in taxation, education, health, welfare, transportation and regulatory policies; the implementation and administration of national programs in the state and the state's roles in urban affairs.

PS 421 SOVIET AND SOVIET BLOC FOREIGN POLICY**3 (3-0) F S**

Prerequisite: Junior standing

This course examines the elements of continuity and change in Soviet foreign policy from 1917 to the present and the post WW II policies of the Eastern Euro-

pean states. Foreign policy decisions are examined in light of the national interests of the Soviet Union and the Eastern European states. Special attention is given to the emergence of polycentrism, the Sino-Soviet split, and Soviet and bloc relations with the West.

PS 431 INTERNATIONAL ORGANIZATION

3 (3-0) S

A study of the evolving machinery and techniques of international organization with particular emphasis on the establishment, operation and development of the United Nations.

PS 461 PUBLIC OPINION IN DEMOCRACIES

3 (3-0) S

Prerequisite: Three hours politics

The course is designed to develop a knowledge of the nature of public opinion and its functions in a democratic system of government. It focuses primarily on public opinion in the United States but also makes comparisons with other nations. The areas of emphasis are: theories concerning opinion formation and functions, public opinion research methodology, public opinion and policy development, and empirical studies on public opinion.

PS 471 LATIN AMERICA IN WORLD AFFAIRS

3 (3-0) S

Prerequisite: PS 376 or consent of instructor

This course examines the role of the Latin American states in world affairs as individual states and as a region acting through international organizations. Attention is given to the historical, political, economic, social and geographic forces conditioning the foreign policies of these countries. Emphasis is placed on the relations of the Latin American countries with the United States.

PS 472 SOVIET POLITICS

3 (3-0) S

This course focuses on the contemporary Soviet political system, its structure, functions and processes, with brief consideration of the historical and ideological base of Soviet politics. As a course in comparative politics, the analysis will proceed within a framework designed to elucidate the similarities and differences of the Soviet system with other political systems. In addition, the Soviet system will be tested against a theoretical model of totalitarian dictatorships.

PS 473 POLITICAL SYSTEMS OF NEW STATES

3 (3-0) F

This course explores the general characteristics of the political systems of the new states in Asia and Africa. Following a brief survey of the pattern and nature of colonialism, the independence movements, and the contemporary social and economic conditions of the new states, the course focuses on political ideologies, elites, and organizations and processes. Particular attention is given to the role of intellectuals and the military. The course concludes with an examination of major political, social and economic problems.

PS 485 AMERICAN POLITICAL THOUGHT

3 (3-0) S

A study of the evolving currents and cross-currents of political thought that have helped to shape or to explain the actions of leaders and people from the Puritans to the New Frontiersmen, from John Winthrop and Roger Williams to John Dewey and J. K. Galbraith.

PS 491, 492 SEMINAR IN POLITICS

3 (3-0) F S

Prerequisites: Senior standing in politics; for others, consent of department

Required of seniors majoring in or concentrating in PS, open to other seniors and graduate students with consent of department.

Emphasizing intensive independent work on selected topics, this seminar develops the student's skills in the methodology of the discipline and stresses familiarity with the literature and other resources of political science.

PS 494, 495 (EC 494, 495, SOC 494, 495) URBAN SEMINAR 3 (3-0) F S

Prerequisite: Junior standing

A study of urban and urban-related problems through theories from the disciplines of politics, sociology and economics, and their application to an existing environment. Intermixed with formal study will be field research in various local communities. In addition, students will be involved with both public and private agencies and with local leaders in ongoing programs in Raleigh and adjacent communities.

PS 496 GOVERNMENTAL INTERNSHIP AND SEMINAR 3-6 Credits Arranged F S

Prerequisites: Junior standing, approval of selection committee

Involving formal seminars; lecture-discussions by political scientists, legislators, executives, judges, representatives of special interests and news media; four to six hours a day working on assignment to and under supervision of legislators or executives; formal report at completion of an internship covering the various aspects of the program.

PS 498 SPECIAL TOPICS IN POLITICS 3-6 F S

Prerequisite: Six hours politics

The student will make a detailed investigation of a special topic in politics. The topic and mode of study will be determined by the student and a member of the department's faculty.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PS 500 POLITICAL THOUGHT: PLATO TO THE REFORMATION 3 (3-0) F

Prerequisite: Consent of instructor

The emergence and development of the theories underlying or explaining the political aspects of behavior, approached through the study of the writings of the principal political philosophers from the days of the Greek city-state to the Reformation.

PS 501 MODERN POLITICAL THEORY 3 (3-0) S

Prerequisite: Consent of instructor

A study of the state and its relationship to individuals and groups, approached through reading of selected passages from the works of outstanding philosophers from the 16th century to the present.

PS 502 (ED 502) PUBLIC ADMINISTRATION 3 (3-0) F S

Prerequisite: PS 200 or PS 201 or consent of instructor

A study of the factors which contribute to goal displacement in public agencies and the institutions, concepts and techniques which may be used in such agencies to reduce the effects of these factors.

PS 503 COMPARATIVE ADMINISTRATION 3 (3-0) F S

Prerequisite: PS 502 or PS 473 or consent of instructor

Concentration will be on administrative systems of developing nations with limited attention to developed systems. The major emphasis will be on administrative aspects of governmental change and modernization in developing nations; colonial influence on administration; problems of establishing new nations and adapting to change in established states; bureaucratic development and behavior; theories of development administration.

PS 506 PUBLIC PERSONNEL ADMINISTRATION 3 (3-0)

Prerequisite: PS 502 or consent of instructor

A study in depth of the institutions and the sequence of processes in public

personnel administration. It examines existing practices but is primarily concerned with emerging theories and trends.

PS 507 COLLECTIVE NEGOTIATIONS IN THE PUBLIC SERVICE 3 (3-0)
Prerequisite: PS 200 or consent of instructor

This course includes intensive consideration of the background of collective negotiations movement; analysis of key policy issues, such as bargaining rights and use of strike weapons; framework for collective negotiations; scope and conduct of negotiations; impasse resolution; grievance procedure.

PS 509 SCOPE AND METHOD OF POLITICS 3 (3-0) F
Prerequisite: PS 200 or consent of instructor

This course reviews contemporary theories, concepts and methods fundamental to the study of politics. It emphasizes current empirical research and the collateral involvement in research activities aimed at the development of basic skills in this area.

PS 510 (EC 510) PUBLIC FINANCE 3 (3-0) F S
(See economics, page 286.)

PS 511 THE BUDGETARY PROCESS 3 (3-0) S
Prerequisites: At least nine hours in the social sciences including a course in American Government, consent of instructor

A study of the generalized budgetary process used at all levels of government in the United States. Understanding of the process is based upon comprehension of the institutions involved, the roles of politicians and professionals and the objectives of budgetary systems. The course will also focus upon budgetary reforms and the expanding Planning-Programming-Budgeting System as a management tool.

PS 512 AMERICAN CONSTITUTIONAL THEORY 3 (3-0) F
Prerequisite: PS 200 or equivalent

Basic constitutional doctrines, including fundamental law, judicial review, individual rights and political privileges, and national and state power. Special attention is given to the application of these doctrines to the regulation of business, agriculture and labor and to the rights safeguarded by the First, Fifth and 14th Amendments to the Constitution.

PS 516 PUBLIC POLICY ANALYSIS 3 (3-0) F S
Prerequisites: Graduate standing, advanced undergraduate standing and consent of instructor

This course will focus on the theories and methodology of analyzing and explaining public policy and the substance of recent domestic policies in the human and physical resources area, including welfare, poverty, education, housing, urban renewal, transportation, recreation-conservation and agriculture.

PS 520 URBAN POLITICS 3 (3-0) F
Prerequisite: PS 206

A comparative study of political conditions in cities and localities. Topics will include the formal structures and rules of city and metropolitan governments, and the relationships to the informal norms and distribution of power; patterns of local decision making; elite recruitment and citizen participation; variations of local autonomy and the scope of local politics; and approaches to urban policy issues.

PS 521 PROBLEMS IN URBAN AND METROPOLITAN AREA GOVERNMENT 3 (3-0) F
Prerequisite: PS 206 or consent of instructor

This course examines theory and research on problems affecting governments in metropolitan areas. Principal attention is given to those problems which affect

(or result from) governmental structure, institutions and politics and to the alternative approaches to their solution.

PS 531 THE LEGISLATIVE PROCESS

3 (3-0) S

Prerequisite: PS 200 or consent of instructor

A study of the formulation of public policy from the institutional and behavioral viewpoints. Important current legislative problems at the congressional and state legislative levels will be selected and will serve as a basis for analyzing the legislative process.

PS 532 THE CHIEF EXECUTIVE

3 (3-0) F

Prerequisite: PS 200 or consent of instructor

This course will focus upon three major concepts of the office of the chief executive, as developed under several incumbents. First are the institutions which surround that office and which facilitate the expansion of its power and operations. Next are the various roles, which are played by different chief executives. Last are the processes of leadership by which the chief executive can attempt to direct the machinery of government to achieve predetermined objectives.

PS 533 THE JUDICIAL PROCESS

3 (3-0) S

Prerequisite: PS 200 or consent of instructor

A comparative examination of the judicial process in the United States, England and France. After a brief examination of the nature and main categories of law, the course will cover such matters as staffing of courts, the participants in litigation, the American judicial system, special consideration of the role of the U. S. Supreme Court, court systems in the countries listed above and finally a thorough examination of judicial review in action. Administrative tribunals will receive some attention.

PS 542 GOVERNMENTAL PLANNING

3 (3-0) F

Prerequisite: PS 502

A study of the planning function at all levels of government in the United States, with particular attention to the problems posed for planning by the rapid growth of metropolitan areas.

PS 572 SEMINAR IN COMPARATIVE POLITICS

3 (3-0) S

Prerequisite: One course in comparative politics

This seminar will open with a survey of the problems and methods of comparative political analysis, after which students will be assigned a specific, limited subject to be examined within the framework of a systematic, analytical scheme appropriate to the topic. Specific topics will be drawn from the subjects of political ideologies, political groups, political elites and decision-making institutions and processes.

PS 575 POLITICAL DEVELOPMENT

3 (3-0) F S

Prerequisite: Nine hours politics

This course examines the concept, theories, characteristics and problems of political development. Within a broad historical framework, particular subjects are analyzed in relationship to political development. These subjects include, among others, political culture, political integration, political institutions, military forces and economic development. Data derived from comparative cultural and political studies are employed in an attempt to discover patterns of change related to political development.

FOR GRADUATES ONLY

PS 601 SEMINAR IN PARTY AND GROUP POLITICS

3 (3-0) S

PS 602	SEMINAR IN LEGISLATIVE PROBLEMS	3 (3-0) F
PS 603	SEMINAR IN ADMINISTRATIVE PROBLEMS	2-4
PS 604	SEMINAR IN JUDICIAL PROBLEMS	3 (3-0) S
PS 605	SEMINAR IN ORGANIZATION THEORY	3 (3-0) S
PS 606	SEMINAR IN POLICY AND ADMINISTRATION	3 (3-0)
PS 621	SEMINAR IN INTERNATIONAL POLITICS	3 (3-0) F
PS 696	SEMINAR IN POLITICS	2-4 F
PS 699	RESEARCH IN POLITICS	Credits Arranged F S

POULTRY SCIENCE

FOR UNDERGRADUATES

PO 201	POULTRY PRODUCTION	4 (3-3) F S
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Principles of broiler, market egg, hatching egg and turkey production as well as emphasis on the anatomy and physiology of the chicken. Breeding, incubation, raising, housing, feeding, disease and parasite control, marketing of chickens, eggs and turkeys.
Messrs. Parkhurst, Prince

PO 301	POULTRY QUALITY EVALUATIONS	2 (1-3) F
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Prerequisite: PO 201 or consent of instructor

Evaluation of poultry for production and standard qualities; determining market quality of poultry and eggs.
Mr. Parkhurst

PO 351	POULTRY GRADING	1 (0-3) F
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Prerequisite: PO 301

Laboratory experience in determining federal grades of poultry and eggs.

Mr. Parkhurst

PO 401	POULTRY DISEASES	4 (3-2) S
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The major infectious, noninfectious and parasitic diseases of poultry are studied with respect to economic importance, etiology, susceptibility, dissemination, symptoms and lesions. Emphasis is placed upon practices necessary for the prevention, control and treatment of each disease.
Mr. Colwell

PO 402	COMMERICAL POULTRY ENTERPRISES	4 (3-2) S
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Principles of incubation of chicken and turkey eggs; hatchery management; organization and development of plants for the operation and maintenance of a commercial poultry farm for meat and egg production; study of the types of buildings, equipment and methods of management currently employed by successful poultrymen in North Carolina. Problem.
Staff

PO 404 (FS 404)	POULTRY PRODUCTS	3 (2-3) F
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(See food science, page 318.)

PO 415 (ANS 415, NTR 415)	COMPARATIVE NUTRITION	3 (3-0) F
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Prerequisite: CH 220 or CH 221

Fundamentals of animal nutrition, including the classification of nutrients, their

requirement and general metabolism by different species for health, maintenance, growth and other productive functions. Messrs. Donaldson, Ramsey

PO 490 POULTRY SEMINAR

1 (1-0) F S

Current topics and problems relating to poultry science and to poultry industry are assigned for oral report and discussion. Two semesters. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PO 520 (GN 520) POULTRY BREEDING

3 (2-2) F

Prerequisite: GN 411

Application of genetic principles to poultry breeding considering physical traits and physiological characteristics—feather patterns, egg production, hatchability, growth, body conformation and utility. Mr. Blow

PO 524 (ZO 524) COMPARATIVE ENDOCRINOLOGY

4 (3-3) S

Prerequisite: ZO 421 or ZO 414

Study of the endocrine system with respect to its physiological importance to metabolism, growth and reproduction. Mr. Prince

FOR GRADUATES ONLY

NOTE: Graduate courses may not be offered if registration for the course is too low or if faculty or facilities become unavailable.

PO 698 SPECIAL PROBLEMS IN POULTRY SCIENCE

Maximum 6 F S

PO 699 POULTRY RESEARCH

Credits Arranged F S

PRODUCT DESIGN

PD 321, 322 COLLOQUIUM I, II

1 (1-0) FS

A survey of the historically evolving passive and active interaction of the arts, technological, sociological and psychological forces. Lectures by professional authorities (faculty and guests) and discussions under their guidance. Required selected reading and field experience. Mr. Baermann

PD 400 INTERMEDIATE PRODUCT DESIGN (SERIES)

4 (6-3) FS

Prerequisite: DN 202 or equivalent or consent of department

This group of courses shall be concerned with various social/economic age groups, various forms and rates of production, and various natural and synthetic materials. Messrs. Foote, Masterton

PD 411, 412 APPLIED PHYSICAL PRINCIPLES

3 (2-2) FS

Prerequisite: Intermediate design standing

Various experiments applying physical principles to product design and development. Staff

PD 421, 422 COLLOQUIUM III, IV

1 (1-0) FS

Continuation of Colloquium I, II (PD 321, 322), treating various phases of the subject in depth. Special emphasis on communication, communication systems and

media of communication. Faculty, guest lecturers, discussion and "field experience".
Required selected reading. Mr. Baermann

PD 431, 432 OFFICE AND INDUSTRIAL PRACTICE I, II 1 (1-0) FS
Study of the ethics, organization and procedures of professional product design practice; patent law. Mr. Baermann

PD 440 INTERMEDIATE VISUAL DESIGN (SERIES) 4 (6-3) FS
Prerequisite: DN 202 or equivalent or consent of department

Intermediate investigations of the visual environment through the agency of various materials and processes leading to professional competence in visual design. Mr. Hedge

PD 490 INTERMEDIATE SPECIAL PROJECTS (SERIES) 2 (1-3) FS
Special projects guided by various faculty specialists involved in areas supplementary to product design and visual design option. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PD 501, 502 PRODUCT DESIGN V, VI 7 (3-12) FS
Prerequisite: PD 400 or graduate standing

PD 501—Unlimited production systems designed with object(s) possibilities produced additively of new synthetic materials utilizing new molecular joining for national class and age groups. PD 502—Unlimited production systems designed with object(s) possibilities produced additively of new synthetic materials utilizing new molecular joining for international class and age groups. (Individually selected problems within interdisciplinary team organizations.) NOTE: It shall be assumed that the program is cumulative and that these statements are problem parameters, exclusive of communication requirements. Mr. Foote

PD 511, 512 MATERIALS AND PROCESSES V, VI 2 (1-3) FS
Prerequisite: Graduate standing

Advanced studies in mass production processes and their influence on design. Emphasis placed on material search and process selection in relation to cost, function, human factors, form, finishes and joining methods, as indicated by the current design projects in which the students are involved. Mr. Foote

PD 532 OFFICE AND INDUSTRIAL PRACTICE 1 (1-0) FS
Prerequisite: PD 432 or graduate standing

Advanced studies and procedures of professional product design practice, product and industrial planning, and patent law. Mr. Baermann

PD 541, 542 ADVANCED VISUAL DESIGN I, II 6 (3-9) FS
Prerequisites: ARC 400, LAR 400, PD 400, PD 440; waiver of prerequisites is at the discretion of the instructor

Application of previous studies in design and visual communications to a wide variety of visual problems presented by our physical environment. Mr. Hedge

PD 590, 591 SPECIAL PROJECTS 3 (1-6) FS

Special projects of an interdisciplinary nature, guided by various faculty specialists involved in areas supplementary to product design. Emphasis placed on latest technological development of new materials. Also emphasis on concept of new useful designs for the mass market. The production aspects of products such as materials, processes, functions, human factors, form, sales appeal, finishing and assembly methods and packaging will be stressed in special project designs. Staff

FOR GRADUATES ONLY

PD 601, 602 ADVANCED PRODUCT DESIGN VII, VIII 6 (0-18) FS

PD 631, 632 ADVANCED CONCEPTS IN PRODUCT ENGINEERING 3 (3-0) FS

PSYCHOLOGY

FOR UNDERGRADUATES

PSY 200 INTRODUCTION TO PSYCHOLOGY 3 (3-0) F S

A study of the general characteristics of human behavior, including motivation, learning, development, thinking, perception, sensation and measurement. The objectives are: development of the ability to communicate in oral and written form accurately and scientifically about behavior; development of an understanding of and a capacity to use scientific ideas and processes as they apply to behavior; an understanding of the behavior of organisms. Staff

PSY 210 PSYCHOLOGICAL ANALYSIS APPLIED TO CURRENT PROBLEMS 3 (3-0) F S
Prerequisite: PSY 200

This course will seek to develop skill in the analysis and understanding of certain current problems through the use of psychological knowledge and techniques. The problems to be studied will be selected each time the course is offered, from such topics as: the effects the automation, the racial crisis, international conflict, human development, population control, etc. One of the chief criteria for the selection of topics will be the existence of a substantial scientific psychological literature in the area. Messrs. Cook, Miller

PSY 300 SENSATION AND PERCEPTION 3 (2-2) S
Prerequisites: PSY 200, sophomore standing; introductory physics or chemistry recommended

An introduction to the anatomy and physiology of the major sensory systems, their relation to central and motor structures, and the elementary facts of sensory psychophysics. An extensive survey of the chief determiners of perception, including stimulus properties, extraneous environmental factors, and organismic variables such as learning and motivation. Laboratory studies of classical problems in perception. Mr. Lubow

PSY 302 PSYCHOLOGY OF PERSONALITY AND ADJUSTMENT 3 (3-0) F
Prerequisite: PSY 200

A study of the factors involved in the development of the normal personality, emphasizing the principal factors controlling human behavior and their relationship to adjustment mechanisms. Messrs. Corter, Norton

PSY 304 EDUCATIONAL PSYCHOLOGY 3 (3-0) F S
Prerequisite: PSY 200

A study of learning, instruction, motivation and evaluation in the context of educational practice. Messrs. Cole, Gardner, Johnson, Miller

PSY 310 LEARNING AND MOTIVATION 3 (2-2) F
Prerequisites: PSY 200, PSY 300 recommended

The objectives of this course are (1) to acquaint students with the structure of the areas of learning and motivation and with the major theories and empirical findings in these areas; (2) to develop skill in deriving and testing implications of theories and in manipulating theoretical concepts. Messrs. Cole, Newman

PSY 320 COGNITIVE PROCESSES
Prerequisites: PSY 200, PSY 310

3 (2-2) S

This is a course in complex cognitive processes such as: thinking, reasoning, problem solving, creativity and originality, intelligence, social interaction, verbal behavior and decision processes. It will emphasize theoretical approaches, research findings, and will aim at developing skills in deriving and testing hypothesis in these areas.

Mr. Newman

PSY 337 INDUSTRIAL PSYCHOLOGY I
Prerequisite: PSY 200

3 (3-0) F S

The application of psychological principles to the problems of industry and business; work methods, fatigue, motivation and morale, job analysis, performance measurement.

Staff

FOR ADVANCED UNDERGRADUATES

PSY 411 SOCIAL PSYCHOLOGY
Prerequisite: PSY 200

3 (3-0) S

The individual in relation to social factors. Socialization, personality development, communication, social conflict and social change.

Mr. Luginbuhl

PSY 441 (IE 441) HUMAN FACTORS IN EQUIPMENT DESIGN
Prerequisite: PSY 337 or IE 352 or EC 426 or consent of instructor

3 (2-2) F

Human factors in the design of machines and other equipment. Items of equipment are understood as extensions of man's capacity to sense, comprehend and control his environment. Includes problems in the psychology of information, communication, control and invention.

Mr. Pearson

PSY 475 CHILD PSYCHOLOGY
Prerequisite: PSY 200 or PSY 304

3 (3-0) S

Emphasis will be placed upon the intellectual, social, emotional and personality development of the child. Physical growth will be emphasized as necessary to an understanding of the psychological development of the pupil.

Mr. Gardner

PSY 476 PSYCHOLOGY OF ADOLESCENCE
Prerequisite: PSY 200

2 (2-0) F S

A study of adolescent behaviors considered to be important to their education. Emotional, social intellectual and personality development are emphasized.

Mr. Gardner

PSY 491, 492 SEMINARS IN PSYCHOLOGY
Prerequisites: Senior standing, consent of department

3 (0-3) F S

This course is designed to provide the undergraduate psychology major with skill in designing and conducting independent research studies; knowledge of sources and skill in locating information pertaining to behavior; knowledge of major trends in selected areas of study; knowledge of the research techniques available to the psychologist, knowledge of the organization of psychology as a profession; and an understanding of the code of ethics for psychologists.

Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PSY 500 PERCEPTION AND COGNITION
Prerequisite: Graduate standing

3 (2-2) S

The first half of the course will be a summary and analysis of the major classes

of variables affecting sensation and perception. The data will be examined in the context of the development of theories of perception with emphasis on the general problem of scientific method and theory construction as the specific content of perceptual theory. The second half of the course will summarize and analyze the major modes of thinking and the variables affecting the thinking process. Special emphasis will be placed on the relationship between perception and thinking, and a number of the theories of thinking will be evaluated. Mr. Lubow

PSY 502 PHYSIOLOGICAL PSYCHOLOGY 3 (3-0) F
Prerequisites: 12 hours psychology, including PSY 200, PSY 300, PSY 310

A survey of the neuroanatomical and neurophysiological mechanisms of behavior with emphasis upon mammalian neuroanatomy, neural conduction, synaptic transmission and reflex mechanisms. This course is designed to form a basis for advanced study of the neurophysiological requisites of more complex behavioral processes. Mr. LeVere

PSY 503 (ZO 503) COMPARATIVE PSYCHOLOGY 3 (3-0) S
Prerequisites: PSY 310 and BS 100 or consent of instructor

Covers the history of the study of the comparative behavior of organisms; methodological and theoretical problems peculiar to comparative psychology, with emphasis on the ontogeny and evolution of behavior in vertebrate animals. Mr. Gottlieb

PSY 504 ADVANCED EDUCATIONAL PSYCHOLOGY 3 (3-0) F S
Prerequisites: Six hours psychology

A critical appraisal of potential contributions of psychology to the analysis and improvement of instruction. This course provides a laboratory in which the student practices various applications of psychology to instruction.

Messrs. Cole, Gardner, Johnson, Miller

PSY 505 HISTORY AND SYSTEMS OF PSYCHOLOGY 3 (3-0) S
Prerequisites: PSY 200, 300, 310, 320 or consent of instructor or graduate standing

The aim of this course is to acquaint students with the history of psychology and psychological systems and to give students some practice in taking different approaches to a particular problem area. Mr. Cook

PSY 510 LEARNING AND MOTIVATION 3 (3-0) F
Prerequisite: Graduate standing

A systematic analysis of some of the major classes of variables determining behavioral change. Learning variables are analyzed within their primary experimental setting, and emphasis is upon the diversity of the functions governing behavior change rather than upon the development of some comprehensive theory. Both learning and motivational variables are examined as they contribute to changes in performance within the experimental setting.

Messrs. Cole, Newman, Pearson

PSY 514 LOGICAL FOUNDATIONS OF BEHAVIORAL ANALYSIS 3 (3-0) F
Prerequisite: Graduate standing in psychology

An analysis of fundamental considerations involved in the formulation and verification of theories of behavior. Such topics as operationalism, formalism, reductionism, logical analysis and the nature of truth in empirical sciences will be introduced and related to research in various areas of psychological interest. The objectives are to provide insight into the nature of scientific research, to foster the ability to derive empirical hypotheses, to develop facility in designing experimental tests of hypotheses, and to promote effective writing and speaking about psychological theory and experimentation. Messrs. Cook, Drewes

- PSY 520 PERSONALITY AND SOCIAL PSYCHOLOGY** 3 (3-0) F
Prerequisite: Graduate standing
An analysis of the individual and the social systems in which he operates. Systems and concepts of personality, the problem of human variability, the development of personality structure and dynamics, and of human motivation will be considered. The organization of the individual's perception and attitude structure and their relation to his social roles and group memberships will be examined. Processes of conformity, social influence and socialization will also be studied. Mr. Corter
- PSY 530 ABNORMAL PSYCHOLOGY** 3 (3-0) S
Prerequisites: PSY 200, PSY 302
A study of the causes, symptomatic behavior and treatment of the major personality disturbances. Emphasis will be placed on theory, experimental psychopathology and preventive measures. Mr. Duke, Miss Utley
- PSY 531 (ED 531) MENTAL DEFICIENCY** 3 (3-0) S Sum.
(See education, page 294.)
- PSY 535 TESTS AND MEASUREMENTS** 3 (3-0) F S
Prerequisite: Six hours psychology
A study of the principles of psychological testing including norms and units of measurement, elementary statistical concepts, reliability and validity. In addition, some attention is devoted to the major types of available tests such as general intellectual development, tests of separate abilities, achievement tests, measures of personality and interest inventories. Mr. Westbrook
- PSY 540 (IE 540) HUMAN FACTORS IN SYSTEMS DESIGN** 3 (3-0) S
Prerequisites: ST 513 or ST 515; PSY 441 (IE 441) or consent of instructor
Introduction to problems of the systems development cycle, including man-machine function allocation, military specifications, display-control compatibility, the personnel subsystem concept and maintainability design. Detailed treatment is given to man as an information processing mechanism. Mr. Pearson
- PSY 565 ORGANIZATIONAL PSYCHOLOGY** 3 (3-0) S
Prerequisite: Nine hours in psychology
A study of the application of behavioral science, particularly psychology and social psychology to organizational and management problems. Mr. Miller
- PSY 570 THEORIES OF PERSONALITY** 3 (3-0) F
Prerequisite: Graduate standing
A review of theories of personality, with emphasis on research, application in psychotherapy and measurement, and principles involved in similarities and differences among them. Mr. Corter
- PSY 571 INDIVIDUAL INTELLIGENCE MEASUREMENT** 3 (3-0) S
Prerequisite: PSY 520
A practicum in individual intelligence testing with emphasis on the Wechsler-Bellevue, Stanford-Binet, report writing and case studies. Mr. Corter
- PSY 576 DEVELOPMENTAL PSYCHOLOGY** 3 (3-0) F
Prerequisites: Nine hours in psychology, including PSY 475 or PSY 476
A study of the development of human behavior, with attention given to theoretical issues and research in developmental psychology. Messrs. Gardner, Johnson

PSY 578 INDIVIDUAL DIFFERENCES 3 (3-0) F S
 Prerequisites: Six hours in psychology
 Nature, extent and practical implications of individual differences and individual variation. Graduate Staff

PSY 591 AREA SEMINAR IN CLINICAL-COMMUNITY PSYCHOLOGY 1-3 FS
 Prerequisites: Consent of instructor Maximum 6
 The following topics will be dealt with (1) the development of clinical community psychology as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationships to other areas within psychology. Staff

PSY 592 AREA SEMINAR IN EXPERIMENTAL PSYCHOLOGY 1-3 FS
 Maximum 6
 The following topics will be dealt with (1) the development of experimental psychology as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationships to other areas within psychology. Staff

PSY 593 AREA SEMINAR IN HUMAN FACTORS ENGINEERING 1-2 FS
 Prerequisites: Graduate standing Maximum 3
 The following topics will be dealt with (1) the development of human factors as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationships to other areas within psychology. Staff

PSY 594 AREA SEMINAR IN HUMAN RESOURCES DEVELOPMENT 1-3 FS
 Prerequisites: Consent of instructor Maximum 6
 The following topics will be dealt with (1) the development of human resources as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationships to other areas within psychology. Staff

PSY 595 AREA SEMINAR IN SCHOOL PSYCHOLOGY 1-3 FS
 Prerequisites: Graduate standing Maximum 6
 The following topics will be dealt with (1) the development of school psychology as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationships to other areas within psychology. Staff

PSY 596 AREA SEMINAR IN SOCIAL PSYCHOLOGY 1-3 FS
 Maximum 6
 The following topics will be dealt with (1) the development of social psychology as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationships to other areas within psychology. Staff

PSY 599 RESEARCH PROBLEMS IN PSYCHOLOGY Credits Arranged F S
 Prerequisite: Consent of instructor
 Research project for graduate students supervised by members of the graduate faculty. Research to be elected on basis of interest of student, and is not to be part of thesis or dissertation research. Graduate Staff

FOR GRADUATES ONLY

PSY 603 VERBAL LEARNING AND VERBAL BEHAVIOR 3 (3-0) S

PSY 604 CLASSICAL CONDITIONING 3 (3-0) F

PSY 605	INSTRUMENTAL LEARNING	3 (3-0) S
PSY 607	ADVANCED INDUSTRIAL PSYCHOLOGY I	3 (3-0) S
PSY 608	ADVANCED INDUSTRIAL PSYCHOLOGY II	3 (3-0) F
PSY 610	THEORIES OF LEARNING	3 (3-0) F or S
PSY 611	SOCIAL PSYCHOLOGY: SMALL GROUPS RESEARCH	3 (3-0) S
PSY 635	PSYCHOLOGICAL MEASUREMENT	3 (3-0) S
PSY 640 (IE 640)	SKILLED OPERATOR PERFORMANCE	3 (3-0) F
PSY 672	PERSONALITY MEASUREMENT	3 (2-3) FS
PSY 674	PSYCHOLOGICAL INTERVENTION I	3 (2-2) F
PSY 675	PSYCHOLOGICAL INTERVENTION II	3 (2-2) S
PSY 690	SEMINAR IN INDUSTRIAL PSYCHOLOGY	3 (3-0) FS
PSY 691	SPECIAL TOPICS IN PSYCHOLOGY	1-3 F
PSY 693	PSYCHOLOGICAL CLINIC PRACTICUM	Maximum 12 FS
PSY 696	ADVANCED PROBLEMS IN PERCEPTION	3 (2-2) F
PSY 697 (ED 697)	ADVANCED SEMINAR IN RESEARCH DESIGN	3 (3-0) FS
PSY 699	THESIS AND DISSERTATION RESEARCH	Credits Arranged FS

RECREATION RESOURCES ADMINISTRATION

FOR UNDERGRADUATES

RRA 152 INTRODUCTION TO RECREATION 3 (3-0) F S

This course is designed to provide instruction in the areas of history and foundations of recreation including objectives, economic and social aspects, definition and importance; status of organized recreation in our modern society; certain applied principles of recreation.
Staff

RRA 215 MAINTENANCE AND OPERATION I 3 (3-0) F S

Prerequisite: RRA 152

This course deals with methods of operation of various park and recreation facilities for public use; protection and law enforcement; job planning and scheduling; preventive maintenance; and modern maintenance techniques and maintenance materials.
Mr. Warren

RRA 216 MAINTENANCE AND OPERATIONS II 3 (3-0) F S

Prerequisite: RRA 215

This course is a continuation of RRA 215 with emphasis upon water oriented recreation and public camping facilities; swimming pools; beaches, small lake management; marinas; day and family camping.
Mr. Stott

RRA 333 SAFETY PRACTICES IN RECREATION**2 (1-2) F S**

This course stresses first aid and safety education in relation to the home, school and community. It strongly emphasizes safety principles as applied to activities of the gymnasium, playgrounds and athletic fields. Laboratory will provide practice in first aid skills.

Mr. Stott**RRA 341 RECREATION RESOURCE RELATIONSHIPS****3 (3-0) F S****Prerequisite:** Junior or senior standing**Corequisite:** FOR 472

This course is an examination of the concepts and principles involved in identifying and describing natural recreation resource components significant to the management process. Major study is made of the relationships between various governmental agencies and private enterprise in providing forest recreation.

Mr. Moncrief**RRA 353 PUBLIC CAMP ADMINISTRATION****3 (2-2) F S****Prerequisite:** RRA 152

This course surveys the development of organized camping and the educational, health and recreational objectives of camping. Program planning and leadership training in community, private, agency and school camping is emphasized. Laboratory will provide practice in campcraft skills.

Mr. Warren**RRA 354 PERSONAL AND COMMUNITY HEALTH****3 (3-0) F S****Prerequisite:** Junior standing

This course presents the essential present-day knowledge of personal and community health. Emphasis is placed upon health problems, disease prevention, communicable diseases and their control, public health administration, school and industrial hygiene, and various other health problems confronting the individual and community. The course presents valuable and interesting health information to college men and women in order that they might live more intelligently in terms of newer health concepts and also be better prepared to assume their responsibilities as citizens of their respective communities.

Mr. Miller**RRA 358 THE RECREATION PROGRAM****4 (2-4) F S****Prerequisite:** RRA 216

This course includes the types of recreation opportunities to be made available to individuals, groups, neighborhoods or municipalities and the methods of providing these opportunities.

Mr. Sternloff**RRA 359 RECREATION AND PARK SUPERVISION****3 (2-2) F S****Prerequisite:** RRA 358

Supervision is the act of directing, inspecting and critical evaluation. Particular emphasis is focused upon the roles of the public recreation supervisor; community centers, sports, special activities, maintenance and operation.

Mr. Sternloff**FOR ADVANCED UNDERGRADUATES****RRA 405 MANAGEMENT OF REVENUE SOURCES FOR PUBLIC RECREATION****3 (3-0) S****This is an extension course only.**

A study of existing practices of recreation, their operation, methods of finance, scope and problems are emphasized. The interrelationship and interdependence of all forms of organized recreation are stressed.

Mr. Warren**RRA 440 RECREATION RESOURCE INVENTORY AND PLANNING****3 (2-2) F S****Prerequisites:** RRA 341, FOR 472

This course is an examination of concepts and principles which provide a basis

for recreation resource quantification and allocation and factors which are involved in inventorying the physical properties and associated intangible values of the recreation resource on extensive wildlands. The resource planning function is studied as an essential component of the managerial process. Mr. Hammon

RRA 441 RECREATION RESOURCE DEVELOPMENT

3 (3-0) F S

Prerequisite: RRA 440

The recreation resource manager's role in situations typical of the Federal, State and private sectors is examined. Categories of information are reviewed as to their significance in the decision-making and problem-solving process. Competent information systems are examined. Mr. Hammon

RRA 442 WILDLAND RECREATION ENVIRONMENTS

3 (2-3) F S

Prerequisite: RRA 441

A study of environmental modifications and resource developments required to support recreation use. Factors affecting the selection of sites for development are related to resource planning functions. Site planning procedures provide a basis for managerial review. Natural history interpretation is an element of resource management. Concepts of natural beauty are reviewed, and approaches to the preservation of amenities through modified methods of commercial product management are explored. Mr. Warren

RRA 451 FACILITY AND SITE PLANNING

3 (0-6) F S

Prerequisite: RRA 215

This course includes the history of park and recreation facility development and trends in recreation facility planning. Emphasis is placed upon the planning principles involved in the design and layout of recreation areas and recreation buildings. Field trips will enable the student to see the various types of recreation facilities. Mr. Stott

RRA 453 ADMINISTRATIVE POLICIES AND PROCEDURES

3 (3-0) F S

Prerequisite: RRA 359

This course is involved with: the internal organization of the recreation and park department; the administrative process; legislation and legal foundations; boards and commissions; personnel practices and policies; office management; public relations. Mr. Sternloff

RRA 454 RECREATION AND PARK FINANCE

3 (3-0) F S

Prerequisites: Six hours recreation resources administration, senior standing

This course is involved with: recreation and park fiscal administration; sources of finance for current and capital expenditures; revenue activities; financial planning; budgeting; expenditure policies; accounting; auditing and planning for recreation and park services. Mr. Hines

RRA 475 RECREATION AND PARK INTERNSHIP

9 (0-27)

Prerequisites: Senior standing, RRA 359

(9 Weeks) S Sum.

This course is intended to provide the prospective recreator with an opportunity to acquire controlled experiences in skills and techniques involved in the management of a recreation and park department. The student will spend nine weeks off campus in a departmental selected location. Mr. Miller

RRA 491 SPECIAL PROBLEMS IN RECREATION

3 (2-2) F S

Prerequisite: Consent of department

A survey of specific problems in recreation. Aims to develop critical analysis. Forms a basis for the organization of research projects, for the compilation and organization of material in a functional relationship and for the foundation of policies. Follows the seminar procedure. Mr. Moncrief

FOR GRADUATES ONLY

RRA 500 THEORIES OF LEISURE AND RECREATION	3 (3-0)
Prerequisites: Nine hours recreation resources administration	
RRA 501 THEORY DEVELOPMENT IN RECREATION RESEARCH	4 (3-2)
Prerequisites: ST 311, SOC 416	
RRA 691 SEMINAR IN RECREATION ADMINISTRATIVE POLICIES	2 (0-4)
RRA 692 ADVANCED PROBLEMS IN RECREATION	Credits Arranged
RRA 699 RESEARCH IN RECREATION	Credits Arranged

RELIGION

(Also see Philosophy)

FOR UNDERGRADUATES

REL 300 INTRODUCTION TO RELIGION	3 (3-0) F S
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Man's religiousness, a universal and intensely personal phenomenon, appearing in many rich traditions, archaic and Asian as well as Western, is the subject matter of this course. Various aspects of religion are analyzed, including the development of the great traditions, myth and ritual, religious language and aesthetic form, general world view and salvational motif, and the relation of religion to personal maturity, cultural change and the social good. Messrs. Fitzgerald, Highfill, Middleton

REL 311 THE HEBREW BIBLE	3 (3-0) F
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Man's religious quest is explored in the varied Biblical literature of the Hebrews, whose faith and history form a major component of western civilization. The course stresses the development of their religious faith and tradition, but such background matters as geography, archeology, history and literary problems are also considered.

Mr. Highfill

REL 312 CHRISTIAN ORIGINS	3 (3-0) S
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The writings which were produced by the early Christian community and which came to be considered the normative testimony concerning the Christian world view are examined in their historical context. The results of recent studies of the Dead Sea Scrolls as well as of Hellenistic and Hebrew thought and religion are brought to bear on early Christian life and thought.

Mr. Highfill

REL 315 WESTERN RELIGIONS TO THE REFORMATION	3 (3-0) F
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This course traces the major steps in the development of Christianity and Judaism during the period 100-1500 A.D., noting the events, persons and ideas which were most significant in this development. Among the topics discussed are the formation of theology and organization, the ecumenical councils, and the heretical movements in the early centuries; the Eastern churches; the challenge of Islam and the Crusades; and the cycles of decline and revival in the church of Western Europe.

REL 316 WESTERN RELIGIONS SINCE THE REFORMATION	3 (3-0) S
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In this course are considered the major developments within Christianity and Judaism from 1500 to the present. Among the topics of study are the Reformation and the rise of Protestantism, religious thought in the intellectual climate of the

Enlightenment, and the religious response to the new challenges of the 19th and 20th centuries.

REL 321 RELIGION IN AMERICAN LIFE

3 (3-0) F S

This is a study of representative men, movements, and thought in the major religions within the American context. The course traces the historical development of these religious groups and examines the role of religion in the development of American society and culture.

Mr. Fitzgerald

REL 324 RELIGION AND ETHICS

3 (3-0) F S

Religious traditions claim to make distinctive, crucial ethical demands on man. This involvement of religion in moral decision and action is the concern of this course. The insights of the Hebrew-Christian tradition, along with those of other traditions, are studied in their relationship to some of the crucial problems of modern man.

Mr. Highfill

REL 327 CONTEMPORARY RELIGIOUS THOUGHT

3 (3-0) F S

This course investigates the several lines of development of religious thought which have resulted from attempts to reconcile traditional religious concepts with the rapidly changing intellectual and social scene. Among the topics considered are the nature of religion in a secular age, ideas of God, the functions of religious institutions, and interfaith relations.

Mr. Fitzgerald

REL 331 HINDUISM AND ISLAM

3 (3-0) F

The rich religious traditions of India are studied, including early Vedic religion, Brahmanism, the various Yogas, the devotion cults, the religio-philosophical traditions, modern religious movements, and also separatist traditions such as those of the Jains and Sikhs. Islam, the religious tradition of about 10 percent of the Indian population, is examined in its Arabian origins and as it has developed in other parts of the world.

Mr. Highfill

REL 332 BUDDHISM

3 (3-0) S

Buddhism, the integrating religious force in Asia, is followed from its beginnings in India through the expansion into the whole of Asia, including China, Japan and Southeast Asia. Creativity in art, political involvements, the role of the monastic community, meditative disciplines, as in Zen, and new sects, as in Japan, are some of the facets of this study.

Mr. Highfill

REL 498 SPECIAL TOPICS IN RELIGION

1-6 F S

Prerequisite: Six hours religion

This course has no fixed description and is used to offer areas of study which appear only rarely in the curriculum and will also function as a readings course for honors students in religion.

REL 590 (EM 590, PHI 590) TECHNOLOGY AND HUMAN VALUES

3 (3-0) FS

(See engineering mechanics, page 308.)

SOCIAL STUDIES

(See University Studies)

SOCIOLOGY

(Also see Anthropology)

FOR UNDERGRADUATES

SOC 202 PRINCIPLES OF SOCIOLOGY

3 (3-0) F S

Introduction to the scientific study of man's behavior in relation to other men, the general laws affecting the organization of such relationships and the effects of social life on human personality and behavior.

SOC 204 NORTH CAROLINA AND THE CHANGING SOUTH

2 (2-0) F S

This course is designed to give students an understanding of the dynamic nature of North Carolina. The State is placed in perspective with respect to the Southern region and its place in the Nation. Considerable emphasis is given to the changes which are taking place including the nature, diversity and intensity of these changes. Similarly, the changes are placed in historical perspective in terms of cultural continuity. Students will investigate the major social movements under way in the State and region with respect to the goals of and the tactics employed in these social movements.

SOC 301 HUMAN BEHAVIOR

3 (3-0) F S

A study of the effects of social interaction upon individual behavior and personality; collective attitudes and behavior as products of group experience; analysis of fashions and fads, crowds, mobs, publics, social movements.

SOC 302 MASS COMMUNICATIONS AND MODERN SOCIETY

3 (3-0) F S

The development and composition of social groups and the processes involved in group organization. These are analyzed in terms of the expanding functions of mass communication in contemporary society.

SOC 303 CURRENT SOCIAL PROBLEMS

3 (3-0) F S

Study of the social and cultural aspects of specific problems such as crime, divorce, race conflict, illness, poverty, housing, recreation and personality adjustment to demonstrate the basic integration of society and community life.

SOC 304 CONTEMPORARY FAMILY LIFE

3 (3-0) F S

The social organization of the family with special attention to socialization, marital choice, kinship relations and the social changes affecting family structure and functions.

SOC 305 RACE RELATIONS

3 (3-0) F S

Analysis of race relationships both in the United States and throughout the world with particular emphasis on factors producing the changes taking place at the present time.

SOC 306 CRIMINOLOGY

3 (3-0) F S

The study of causation, treatment, prevention and control of criminality and juvenile delinquency. Special emphasis is placed on sociocultural theories of causation and on the examination of court and correctional systems for adults and juveniles. Arranged field trips.

SOC 315 SOCIAL THOUGHT

3 (3-0) F S

Prerequisite: SOC 202 or equivalent

The development of social thought from lore to science; historical changes in explanatory systems of human behavior; theories of the individual, group culture,

community and society; the emergence of sociological systems of analysis; the role of the sociologist in the study of social phenomena including planned change.

SOC 318 (ED 318) EDUCATIONAL SOCIOLOGY

3 (3-0) F S

Prerequisites: Three hours sociology

An investigation of the educational institution in a sociological framework. Analyzes the school as a social system, roles of the functionaries of education, relationships within the student body, effects of social factors upon the learning experience, reciprocal school-community relationships, adult education and higher education in American society.

SOC 341 RURAL SOCIETY—U. S. A.

3 (3-0) F S

Prerequisite: SOC 202 or equivalent

The application of basic sociological concepts to rural life. Major rural social institutions, ecological patterns and land tenure systems are examined with emphasis upon the American setting. Influence of rural patterns and values in contemporary urbanized society is examined. Stress is placed upon the role of the rural community as an area of institutional functioning and social integration within the framework of a complex, industrial society.

SOC 342 RURAL SOCIETIES AROUND THE WORLD

3 (3-0) F S

Prerequisite: SOC 202 or equivalent

Sociological description, analysis and understanding of traditional rural societies of Asia, Africa and Latin America. Basic social institutions, groupings and processes are examined to provide bases for understanding these societies in the context of an increasingly urbanized and industrialized world. Major emphasis is placed on examining these societies on a Gemeinschaft-Gesellschaft continuum.

FOR ADVANCED UNDERGRADUATES

SOC 401 HUMAN RELATIONS IN INDUSTRIAL SOCIETY

3 (3-0) F S

Prerequisites: Senior standing, consent of instructor

Studies in the sociology of occupations, professions and work, with special attention to human relations in industrial plants and other work situations.

SOC 402 URBAN SOCIOLOGY

3 (3-0) F S

Prerequisite: SOC 202 or consent of instructor

A study of the factors in the growth of cities; the relationship between the design of cities and their social organization; detailed analysis of new developments in the serving of human needs. City and regional planning.

SOC 405 SOCIAL WORK I

3 (3-0) F

Prerequisites: SOC 202, consent of instructor

A course designed to acquaint students with the various types of public and voluntary social work and with remedial and preventive programs in applied sociology, social psychiatry, health, public welfare and recreation.

SOC 406 SOCIAL WORK II

3 (2-2) S

Prerequisites: Six hours sociology, consent of instructor

The subjects covered include emergence and present status of social work as a profession, roles, role conflict, and the generic base of methods in social work. Attention is focused on casework, group work and community organization. Some time is devoted to research efforts and to modes of administration. Each student is given an opportunity to participate in the current operations of one agency in the community.

SOC 411 COMMUNITY RELATIONSHIPS**3 (3-0) F S****Prerequisites:** SOC 202, consent of instructor

A survey of the institutions, organizations and agencies found in modern communities; social problems and conditions with which they deal; their interrelationship and the trend toward over-all planning.

SOC 414 SOCIAL STRUCTURE**3 (3-0) F S****Prerequisites:** Six hours sociology, consent of instructor

Studies of the major social institutions and systems of stratification; the organization of social studies of the major social institutions and systems of stratification; the organization of social systems as, for example, religion, education and government; the functions of such structural components as age and sex groups, vocational and professional groups, and social classes.

SOC 416 RESEARCH METHODS**3 (3-0) F S****Prerequisites:** Six hours sociology and ST 311 or nine hours sociology

An analysis of the principle methods of social research; the development of experiments; schedules and questionnaires; the measurement of behavior.

SOC 425 JUVENILE DELINQUENCY**3 (3-0) F S****Prerequisite:** SOC 306 or six hours social science

The epidemiology of juvenile delinquency is explored. Descriptive typologies are compared. Theories of causation are developed with emphasis on social institutions, peer groups and socialization processes. Procedures for enforcement, adjudication and correction of young offenders are investigated. Strategies for prevention of delinquency are examined. Opportunities for observation and participation in agency operations are included.

SOC 451 POPULATION AND PUBLIC AFFAIRS**3 (3-0) F S****Prerequisite:** SOC 202 or equivalent

Growth rates, changing composition and residential redistribution are studied in relation to public issues and planning. Attention is given to the ways in which population data are utilized by public agencies in program and policy formulation. Analysis encompasses new problems and socioeconomic situations which develop as a consequence of the dynamic nature of population changes in contemporary society.

SOC 490, 491 SENIOR SEMINAR IN SOCIOLOGY**3 (3-0) F S****Prerequisite:** Consent of department

This course is of an integrative nature giving the student an opportunity to synthesize knowledge, theory and methods learned in earlier courses and to conduct original explorations in areas of special interest.

SOC 494, 495 (EC 494, 495, PS 494, 495) URBAN SEMINAR**3 (3-0)**

(See politics, page 413.)

SOC 498 SPECIAL TOPICS IN SOCIOLOGY**1-6 FS****Prerequisite:** Six hours sociology above the freshman level

The student will make a detailed investigation of a special topic in sociology or anthropology. The topic and mode of study will be determined by the faculty member(s) in consultation with the Head of the Department of Sociology and Anthropology.

FOR GRADUATES AND ADVANCED UNDERGRADUATES**SOC 501 (ED 501) LEADERSHIP****3 (3-0) F S****Prerequisite:** SOC 202 or equivalent

A study of leadership in various fields of American life; analysis of the various

factors associated with leadership; techniques of leadership. Particular attention is given to recreational, scientific and executive leadership procedures.

SOC 502 SOCIETY, CULTURE AND PERSONALITY

3 (3-0) F S

Prerequisite: SOC 202 or equivalent

Human personality is studied from its origins in primary groups through its development in secondary contacts and its ultimate integration with social norms. While comparative anthropological materials will be drawn upon, emphasis is placed upon the normal personality and the adjustment of the individual to our society and to our culture. The dynamics of personality and character structure are analyzed in terms of the general culture patterns and social institutions of society.

SOC 503 CONTEMPORARY SOCIOLOGY

3 (3-0) F S

Prerequisite: Graduate standing

The basic purpose of this course is to provide the student with an overview of the current status of sociological theory and research. It will introduce the student to contemporary sociological thinking and research and provide a base for further graduate training in the discipline.

SOC 504 EDUCATION IN MODERN SOCIETY

3 (3-0) F S

Prerequisite: SOC 202, SOC 301 or equivalent

An analysis of education using basic sociological concepts. Varying emphasis will be placed upon the historical development of education in the United States, cross-cultural comparisons of educational structure and function, professionalization of educators, investigation of the ecological factors affecting education, effects of group processes upon learning, and the effects of social processes and changes upon the educational institution.

SOC 505 THE SOCIOLOGY OF REHABILITATION I

3 (3-0) F

Prerequisite: Graduate standing and/or consent of instructor

The area of disability and handicap is introduced from a conceptual and theoretical standpoint. Sociological and social-psychological aspects of handicaps, the rehabilitation processes and rehabilitative organizations are stressed throughout. Particular attention is given to rehabilitation of the sociology of work in the rehabilitation processes. Socio-cultural factors in disability and handicap (residence, social class, family relationships, etc.) are analyzed in depth.

SOC 506 THE SOCIOLOGY OF REHABILITATION II

3 (3-0) S

Prerequisite: Graduate standing and/or consent of instructor

Students will be expected to engage in individual research projects on a specific handicap, a rehabilitation process or a rehabilitative agency or subagency. An attempt will be made through lectures and discussions to give the student perspective concerning the actual work of rehabilitation in process while he is pursuing his specialized interest. Emphasis will be placed on sociological methods and techniques applicable to the study of the above aspects of social behavior.

SOC 509 POPULATION PROBLEMS

3 (3-0) F S

Prerequisite: SOC 202 or equivalent

A study of population growth, rates of change and distribution. Considerable attention is given to the functional roles of population, i.e., age, sex, race, residence, occupation, marital status and education. The dynamic aspects of population are stressed: fertility, mortality and migration. Population policy is analyzed in relation to national and international goals. A world view is stressed throughout.

SOC 510 INDUSTRIAL SOCIOLOGY

3 (3-0) F S

Prerequisite: SOC 202 or equivalent

Industrial relations are analyzed as group behavior with a complex and dynamic

network of rights, obligations, sentiments and rules. This social system is viewed as an interdependent part of total community life. The background and functioning of industrialism are studied as social and cultural phenomena. Specific social problems of industry are analyzed.

SOC 511 SOCIOLOGICAL THEORY 3 (3-0) F S
Prerequisites: Six hours sociology and graduate standing or consent of instructor

Study of the interdependence of theory and method; the major theoretical and methodological systems; and examination of selected cases of research in which theory and method are classically combined.

SOC 512 FAMILY ANALYSIS 3 (3-0) F S
Prerequisite: SOC 202 or equivalent

This course examines the basic theoretical and methodological framework in sociology within which contemporary family research is conducted.

SOC 513 (ED 513) COMMUNITY ORGANIZATION 3 (3-0) F S
Prerequisite: SOC 202 or equivalent

Community organization is viewed as a process of bringing about desirable changes in community life. Community needs and resources available to meet these needs are studied. Democratic processes in community action and principles of community organization are stressed, along with techniques and procedures. The roles of leaders, both lay and professional, in community development are analyzed.

SOC 522 (ED 522) SOCIAL AND VOCATIONAL ASPECTS OF SENSORY IMPAIRMENT 3 (3-0) Sum.
(See education, page 294.)

SOC 523 SOCIOLOGICAL ANALYSIS OF AGRICULTURAL LAND TENURE SYSTEMS 3 (3-0) F S
Prerequisite: Three hours sociology

A systematic sociological analysis of the major agricultural and land-tenure systems of the world with major emphasis on the problems of family farm ownership and tenancy in the United States.

SOC 533 THEORY OF HUMAN COMMUNICATION BEHAVIOR 3 (3-0) F S
Prerequisites: Six hours sociology or social psychology and graduate standing

This course is organized to introduce students to the behavioral science approach to an understanding of human communication. Communication is treated as a basic social psychological process in which communication events are analyzed in terms of their effects on individual, interpersonal and group behavior. Students will survey the theory, research methods and empirical findings developed in the emerging field of communication. Communication behavior is treated as a mediating mechanism in social interaction.

SOC 534 AGRICULTURAL ORGANIZATIONS AND MOVEMENTS 3 (3-0) F S
Prerequisites: Three hours sociology, American history, American government or a related social science or consent of department

A history of agricultural organizations and movements in the United States and Canada principally since 1865, emphasizing the Grange, the Farmers' Alliance, the Populist revolt, the Farmers' Union, the Farm Bureau, the Equity societies, the Nonpartisan League, cooperative marketing, government programs and present problems.

SOC 541 SOCIAL SYSTEMS AND PLANNED CHANGE 3 (3-0) F S
Prerequisite: Three hours sociology

A study of social agencies and programs and their implementation through

specific organizations in dynamic relation with the people whom they serve. Consideration is given to the relation of these agencies and programs to community structure and forces in society; coordination of the several types of agencies and programs, professional leadership and participation.

SOC 555 SOCIAL STRATIFICATION

3 (3-0) F S

Prerequisite: Six hours sociology

In this course the student would be introduced to the theoretical background, the methodological approaches, and the analysis of the consequences of systems of stratification. Emphasis would be on the static and dynamic qualities of stratification systems in rural and urban-industrial societies as well as the effects of these systems on relations within and between societies. Particular attention will be paid to the integrative and divisive quality of stratification as it is expressed in life styles, world views, etc..

SOC 560 RACIAL AND CULTURAL CONTACTS

3 (3-0) F S

Prerequisite: Six hours sociology or consent of instructor

The course is organized in three sequential sections, the first of which deals with intergroup relations as a legitimate concern of the social sciences. The second consists of an appraisal of cross-cultural data that have been drawn from a variety of situations wherein race and ethnicity figure in a significant manner. Finally, an effort is made to interpret data by delineating observable patterns, trends and relationships.

SOC 565 SOCIOLOGY AND GENERAL SYSTEMS THEORY

3 (3-0) F S

Prerequisites: Six hours sociology, one course in statistics

In this course the student would study the basis of general systems theory and review its application in the field of sociology. Emphasis would be placed on the philosophical nature of systems theory and its potential as an alternative conceptualization to mechanistic and organismic models. Attention will be given to the underlying basis of systems theory; to cybernetics as models of change and control; learning and equilibrium; to information theory as models of choice and selection; to decision theory, and to game theory.

SOC 590 APPLIED RESEARCH

3 (3-0) F S

Prerequisite: SOC 202 or equivalent

A study of the research process with particular emphasis upon its application to action problems. The development of research design to meet action research needs receives special attention.

SOC 591 SPECIAL TOPICS IN SOCIOLOGY

6 (6-0) F S

Prerequisite: Consent of instructor

An examination of current problems in sociology organized on a lecture-discussion basis. The content of the course will vary as changing conditions require the use of new approaches to deal with the emerging problems.

FOR GRADUATES ONLY

SOC 611 RESEARCH METHODS IN SOCIOLOGY

3 (3-0) F S

SOC 613 THEORY OF MASS COMMUNICATION

3 (3-0) F S

SOC 621 SOCIAL PSYCHOLOGY

3 (3-0) F S

SOC 631 POPULATION ANALYSIS

3 (3-0) F S

SOC 632	SOCIOLOGY OF THE FAMILY	3 (3-0) F S
SOC 633	THE COMMUNITY	3 (3-0) F S
SOC 641 (ST 641)	STATISTICS IN SOCIOLOGY	3 (3-0) F S
SOC 652	COMPARATIVE SOCIETIES	3 (3-0) F S
SOC 653	THEORY AND DEVELOPMENT OF SOCIOLOGY	3 (3-0) F S
SOC 690	SEMINAR	Credits Arranged F S
SOC 699	RESEARCH IN SOCIOLOGY	Credits Arranged

SOIL SCIENCE

FOR UNDERGRADUATES

SSC 200	SOILS	4 (3-3) F S
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Prerequisite: CH 103 or CH 107; GY 120 recommended

Fundamentals of soil science: origin, composition and classification of soils; their physical, chemical and biological properties; significance of these properties to soil-plant relationships and soil management.
Mr. Cook

SSC 341	SOIL FERTILITY AND FERTILIZERS	3 (3-0) F
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Prerequisites: SSC 200, BS 100

History of plant nutrition and soil fertility; plant nutrition and growth as related to crop fertilization; fertilizer materials, their manufacture, properties and usage; fertilizer practices related to a sound soil management program.
Mr. Kamprath

SSC 452	SOIL CLASSIFICATION	3 (2-3) S
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Prerequisite: SSC 200

Presentation of factors involved in the genesis, morphology and classification of soils; emphasis upon soil profile properties as operational criteria in the modern classification system; practical field problem in recognition and mapping of soils.
Mr. Cook

SSC 461	SOIL AND WATER CONSERVATION	3 (3-0) F
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Prerequisite: SSC 200 or equivalent

The history and status of erosion and fertility conditions, the economic and social aspects of soil conservation; the effects of climatic factors, vegetation (forest, sod crops, cover crops and soil rotations), soil properties, and other management practices on soil conservation and fertility maintenance.
Mr. Lutz

SSC 462	SOIL MANAGEMENT SYSTEMS	3 (2-3) S
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Prerequisites: SSC 341, SSC 452, SSC 461, CS 211, EC 212

A comprehensive course uniting the subject matter of preceding undergraduate soil science courses with that of allied areas into realistic soil management applications; practical field studies in planning and evaluation of soil management systems.
Mr. Sopher

SSC 472	FOREST SOILS	3 (2-3) S
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Prerequisites: SSC 200, SSC 341 or FOR 452 or equivalent

Soil as a medium for tree growth; the relation of soil physical, chemical and biological factors to the practice of silviculture; extensive soil management in the

forest and intensive soil management in forest nurseries and in seed-tree orchards; the relation of soil and site to current work in genetics, ecology, pathology and entomology. Mr. Davey

SSC 492 SENIOR SEMINAR IN SOIL SCIENCE 1 (1-0) S

Prerequisite: Senior standing in the School of Agriculture and Life Sciences

A student participation course in which students prepare and present thorough and documented discussions of important soil topics. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

SSC 511 SOIL PHYSICS 4 (3-3) F

Prerequisites: SSC 200, PY 212

Physical constitution and analyses; soil structure, soil water, soil air and soil temperature in relation to plant growth. Mr. Lutz

SSC 520 SOIL AND PLANT ANALYSIS 3 (1-6) S

Prerequisites: PY 212, CH 315, at least three soils courses including SSC 341 or consent of instructor

Analytical techniques and chemical instrumentation employed in analysis of soils and plants. Applications to research are emphasized. Mr. Gilliam

SSC 522 SOIL CHEMISTRY 3 (3-0) S

Prerequisites: SSC 200, one year of general inorganic chemistry

A consideration of the chemical and colloidal properties of clay and soil systems, including ion exchange and retention, soil solution reactions, solvation of clays and electrokinetic properties of clay-water systems. Mr. Weed

SSC 532 (MB 532) SOIL MICROBIOLOGY 3 (3-0) S

Prerequisites: CH 220, MB 401

The more important microbiological processes that occur in soils, decomposition of organic materials, ammonification, nitrification and nitrogen fixation. Mr. Bartholomew

SSC 541 SOIL FERTILITY 3 (3-0) F

Prerequisite: SSC 341

Soil conditions affecting plant growth and the chemistry of soil and fertilizer interrelationships; factors affecting the availability of nutrients; methods for measuring nutrient availability. Mr. Kamprath

SSC 551 SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION 3 (3-0) F

Prerequisites: SSC 200, SSC 341, GY 120

Morphology: study of concepts of soil horizons and soil profiles and chemical physical and mineralogical parameters useful in characterizing them; Genesis: critical study of soil forming factors and processes; Classification: critical evaluation of historical development and present concepts of soil taxonomy with particular reference to great groups as well as discussion of logical basis of soil classification. Mr. Buol

SSC 553 SOIL MINERALOGY 3 (2-3) F

Prerequisites: SSC 200, SSC 341, GY 331 or equivalent

Composition, structure, classification, identification, origin, occurrence and significance of soil minerals with emphasis on primary weatherable silicates, layer silicate clays and sesquioxides. Mr. Cook

SSC 560 ADVANCED SOIL MANAGEMENT

3 (3-0) Sum.

Prerequisites: SSC 200, SSC 341

Field studies of selected soil series in the Coastal Plain, Piedmont and Mountain areas of North Carolina; discussion of management practices that should be associated with the various soils under different types of farming. (Offered summer, 1971 and alternate years.)
Messrs. Kamprath, McCracken, Phillips

SSC 590 SPECIAL PROBLEMS

Credits Arranged F S

Prerequisite: SSC 200

Special problems in various phases of soils; emphasis placed on review of recent and current research.
Staff

FOR GRADUATES ONLY**SSC 614 (CS 614, HS 614) HERBICIDE BEHAVIOR IN PLANTS AND SOILS** 3 (3-0) F**SSC 622 SOIL PHYSICAL CHEMISTRY** 3 (3-0) S**SSC 632 (MB 632) ECOLOGY AND FUNCTIONS OF SOIL MICROORGANISMS** 3 (3-0) S**SSC 651 PEDOLOGY** 3 (3-0) F**SSC 671 (BAE 671) THEORY OF DRAINAGE—SATURATED FLOW** 3 (3-0) S**SSC 672 SOIL PROPERTIES AND PLANT DEVELOPMENT** 3 (3-0) S**SSC 674 (BAE 674) THEORY OF DRAINAGE—UNSATURATED FLOW** 3 (3-0) F**SSC 690 SEMINAR** 1 (1-0) F S**SSC 693 COLLOQUIUM IN SOIL SCIENCE** Credits Arranged F S**SSC 699 RESEARCH** Credits Arranged F S**SPEECH**

(Also see English)

NOTE: The prerequisite for all advanced courses in speech is the completion of ENG 111 and ENG 112 with a grade of C or better in at least one semester.

FOR UNDERGRADUATES**SP 210 VOICE AND ARTICULATION** 3 (3-0) F S

A study of the basic processes of the production of speech. Attention given to student's voice quality, articulation, pronunciation and general vocal expression. Speech improvement; help in recognition and reduction of excessive regional sub-standard dialect. Elective for the general student; also required by the School of Education. (Meets requirement of N. C. Department of Public Instruction for Certification of speech proficiency for teachers in *all fields*, except speech. SP 310 required for speech teachers.)
Staff

SP 230 FUNDAMENTALS OF SPEECH 3 (3-0) F S

Directed experience in the various skills of oral communication; public speaking,

group discussion and interpretative reading. Must be taken only as a first course in speech and only in sequence. Staff

SP 231 EXPOSITORY SPEAKING 3 (3-0) F S

A study of the basic theories of informative, report and instructional speaking. Basic rhetorical, audience and idea analysis as well as the delivery of short expository speeches are stressed. Staff

SP 232 PERSUASIVE SPEAKING 3 (3-0) F S

Prerequisite: SP 231

A study of the principles of influencing attitudes and actions through persuasive speaking, with emphasis upon short speeches to stimulate, convince and actuate. Staff

SP 237 GROUP DISCUSSION 3 (3-0) F S

Prerequisite: SP 230 or SP 231

The theory and practice of leading and taking part in such groups as panels, forums, symposiums, conferences and committees. Staff

SP 310 PHONETICS 3 (3-0) F S

A study of the anatomy and movement of the vocal organs in the production of the sounds of speech. Application of the International Phonetic Alphabet to standards of American pronunciation. Study of the major dialect areas of the United States. Recommended as an elective for English majors. Staff

SP 311 INTRODUCTION TO SPEECH CORRECTION 3 (3-0) S

Prerequisite: SP 310

A study of the development of normal speech and hearing. Common speech and hearing defects, and the basic techniques for their prevention and treatment are emphasized. Staff

SP 332 ARGUMENTATION AND DEBATE 3 (3-0) F

Prerequisite: SP 232 or consent of instructor

A study of the process of influencing opinion through the use of logical arguments, with emphasis upon analysis, briefing, evidence, reasoning and refutation. In-class debating also included. Staff

SP 336 PARLIAMENTARY PRACTICE 3 (3-0) F S

Rules and customs of assemblies, including organization, motions; participation in and conduct of meetings; parliamentary strategy. Staff

SP 340 PLAY PRODUCTION 3 (3-0) F S

A survey of methods and techniques in staging dramatic art. Organizing, play selection, casting, directing, acting, scene designs and construction, lighting.

SP 350 FUNDAMENTALS OF RADIO BROADCASTING 3 (2-2) F

A beginning audio production course with laboratory work suitable for both inexperienced and advanced students. Lectures, discussions and demonstrations are arranged to examine the elements of advertising, business, engineering, journalism, politics and show business relevant to American radio broadcasting. Staff

SP 351 RADIO PRODUCTION 3 (2-2) S

Prerequisite: SP 350 or consent of instructor

An advanced course in writing and production for radio. Copy writing, news writing and more complex writing assignments lead to a recorded individual "special" program which is evaluated by the instructor and by the class. The best programs may be broadcast over area radio stations. Staff

SP 361 ORAL READING 3 (3-0) F S

Prerequisites: SP 230 or SP 231

The analysis and presentation of printed materials—literary, technical and semitechnical—for platform, radio and television. Staff

SP 420 DEVELOPMENT OF RHETORICAL THEORY 3 (3-0) F S

Prerequisite: SP 232

A study of the development of rhetorical theory through the Greek, Roman, medieval, renaissance and modern periods. Staff

SP 430 HISTORY AND CRITICISM OF AMERICAN PUBLIC ADDRESS 3 (3-0) F S

Prerequisite: SP 232

A study of the significant political and social speakers in America from colonial times to the present. Analyses of the social settings, of the speeches themselves, and of their impact upon American history are stressed. Staff

SP 450 FUNDAMENTALS OF TELEVISION PRODUCTION 3 (1-4) F

An introduction to the philosophy and techniques of television production. Particular attention is given to instructional and informational programming. Lectures consider television as a communication medium in contemporary society. Laboratory sessions involve the student in studio production of 30-minute television programs. The term project requires each student to "structure", produce and direct a 30-minute program for taping and critique by teacher, professionals and class. Staff

SP 451 ADVANCED TELEVISION PRODUCTION 3 (2-2) S

Prerequisite: SP 450 or consent of instructor

An intermediate course in television and media techniques and applications. For Speech-Communication majors, teacher trainees and others of advanced standing who already have a general knowledge about the operation and basic function of these media.

Lectures relate to advanced theories of media and message. Laboratory periods result in student productions that are analyzed and evaluated in regard to advanced criteria of artistic excellence. Staff

SP 496 SEMINAR IN SPEECH COMMUNICATION 3 (3-0) S

Prerequisite: Consent of department

A research-oriented study of the major periods, movements and personalities in the field of oral communication. Intended to encourage the student to synthesize some aspect of his preceding work in speech. Staff

STATISTICS

FOR UNDERGRADUATES

ST 311 INTRODUCTION TO STATISTICS 3 (2-2) F S

This course relates general statistical concepts to everyday life and emphasizes giving perspective to those concepts: quantitative descriptions of populations, some sampling ideas, techniques of making inferences from samples and the uncertainties involved in making statistical inferences.

Messrs. Hafley, McVay, Stines

ST 361 INTRODUCTION TO STATISTICS FOR ENGINEERS I 3 (3-0) F S
 Prerequisite: College algebra

Survey of statistical techniques useful to engineers and physical scientists. Includes elementary probability, frequency distributions, sampling variation, estimation of means and standard deviations, confidence intervals, significance tests, control charts, elementary least squares curve fitting. Staff

ST 371 INTRODUCTION TO PROBABILITY AND STATISTICS 4 (3-2) F S
 Prerequisite: MA 201

Basic concepts of probability and statistics for students in the physical sciences and engineering; simple probability models, random variables, distributions, functions of random variables, sampling, data description, testing hypotheses, estimation; simple applications of concepts; test of means, variances, goodness-of-fit, randomness, control charts, analysis of variance, regression.

Messrs. Grandage, Manson

ST 421, 422 INTRODUCTION TO MATHEMATICAL STATISTICS 3 (3-0) F S
 Prerequisite: MA 202 or MA 212 or MA 232

Elementary mathematical statistics primarily for students not intending to take further work in theoretical statistics. Includes introduction to probability, common theoretical distributions, moments, moment generating functions, sampling distributions (F, t, chi-square), elementary estimation, hypothesis testing concepts, decision theory concepts and elements of general linear model theory. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ST 501, 502 BASIC STATISTICAL ANALYSIS 3 (3-0) F S
 Prerequisite: ST 311 or equivalent or graduate standing

Basic concepts of statistics; random variables, distributions, statistical measures, estimation, tests of significance, analysis of variance, elementary design and sampling, factorial experiments, multiple regression, analysis of discrete data and other topics. Intended primarily for statistics majors and Ph.D. minors and not intended as a service course for other departments. Mr. Steel

ST 507 STATISTICS FOR THE BEHAVIORAL SCIENCES I 3 (3-0) F

The purpose of this course is to provide a general introduction to descriptive and inferential statistics. Attention will be paid to investigating the role of statistics in behavioral science research as well as presenting the techniques and principles for summarizing data. A basic introduction to inferential statistics will be made with an emphasis on the concepts of hypothesis testing and decision making. The principles and methods will be illustrated by examples and problems from the behavioral science fields. Mr. Wasik

ST 508 STATISTICS FOR THE BEHAVIORAL SCIENCES II 3 (3-0) S
 Prerequisite: ST 507 or consent of instructor

The purpose of this course is to provide further consideration of the use of advanced statistical techniques used in decision making in behavioral science research. Attention will be paid to hypothesis testing and analysis of variance procedures used in the design of experiments. A part of the course will be devoted to topics relating to least squares and multiple regression analysis. Mr. Wasik

ST 511 EXPERIMENTAL STATISTICS FOR BIOLOGICAL SCIENCES I 3 (3-0) F S
 Prerequisite: ST 311 or graduate standing

Basic concepts of statistical models and use of samples; variation, statistical measures, distributions, tests of significance, analysis of variance and elementary experimental design, regression and correlation, chi-square. Staff

ST 512 EXPERIMENTAL STATISTICS FOR BIOLOGICAL SCIENCES II 3 (3-0) F S
Prerequisite: ST 511 or equivalent

Covariance, multiple regression, concepts of experimental design, factorial experiments, individual degrees of freedom, confounded factorial and split-plot designs.
Staff

ST 513 EXPERIMENTAL STATISTICS FOR SOCIAL SCIENCES I 3 (3-0) F
Prerequisite: ST 311 or graduate standing

Basic concepts in collection and analysis of data. Variability of sample data, distributions, confidence limits, chi-square, t-test, analysis of variance, regression, correlation, analytic and descriptive surveys, experimental designs. Mr. McVay

ST 514 EXPERIMENTAL STATISTICS FOR SOCIAL SCIENCES II 3 (3-0) S
Prerequisite: ST 513 or equivalent

Extension of basic statistical concepts to social experiments and surveys; sampling from finite populations and estimating using unrestricted, stratified, systematic and multistage selections; analysis of variance continued; multiple regression; covariance; experimental designs. Mr. Proctor

ST 515, 516 EXPERIMENTAL STATISTICS FOR ENGINEERS 3 (3-0) F S
Prerequisite: ST 361 or graduate standing

General statistical concepts and techniques useful to research workers in engineering, textiles, wood technology, etc. Probability, distributions, measurement of precision, simple and multiple regression, tests of significance, analysis of variance, enumeration data, sensitivity data, life-testing experiments and experimental designs. Mr. Hader

ST 517 APPLIED LEAST SQUARES 3 (3-0) F
Prerequisite: ST 502 or equivalent

Use of least squares estimation in developing numerical descriptions with linear models. Regression, analysis of variance and covariance are considered in a unified manner that does not require an extensive statistical background. Emphasis is placed on the application of these techniques to experimental situations and in broadening the range of problems to which they can be applied (particularly in terms of unequal numbers). A computer will be used for some assigned problems such as matrix inversion. Mr. Warren

ST 521 STATISTICAL THEORY I 3 (2-2) F
Prerequisite: MA 425 (or MA 511)
Corequisites: MA 426 (or MA 512) and MA 405

Discussion of the use of statistics as illustrated by an example, pointing out the need for a probabilistic framework. The probability tools for statistics: description of discrete and absolutely continuous distributions, expected values, moments, moment generating functions, transformation of random variables, marginal and conditional distributions, independence, order statistics, multivariate distributions, concept of random sample, derivation of many sampling distributions. Mr. van der Vaart

ST 522 STATISTICAL THEORY II 3 (2-2) S
Prerequisites: ST 521 and MA 426 (or MA 512)

General framework for statistical inference. Point estimators: biased and unbiased, minimum variance unbiased, least mean square error, maximum likelihood and least squares, asymptotic properties. Interval estimators and tests of hypotheses: confidence intervals, power functions, Neyman-Pearson lemma, likelihood ratio tests, unbiasedness, efficiency and sufficiency. Mr. van der Vaart

ST 531 DESIGN OF EXPERIMENTS 3 (3-0) F
Prerequisite: ST 502 or equivalent

Review of completely randomized, randomized complete block and Latin square designs, and the basic concepts in the techniques of experimental design. Designs and analysis methods in factorial experiments, confounded factorials, response surface methodology, change-over design, split-plot experiments and incomplete block designs. Examples will be used to illustrate application and analysis of these designs. Mr. Monroe

ST 541 (MA 541) THEORY OF PROBABILITY I 3 (3-0) F
(See mathematics, page 367.)

ST 542 (MA 542) THEORY OF PROBABILITY II 3 (3-0) S
(See mathematics, page 368.)

ST 552 BASIC THEORY OF LEAST SQUARES AND VARIANCE COMPONENTS 3 (2-2) F S
Prerequisites: MA 405, ST 521
Corequisite: ST 522

Theory of least squares; multiple regression; analysis of variance and covariance; experimental design models; factorial experiments; variance component models. Staff

ST 561 (EC 561) INTERMEDIATE ECONOMETRICS 3 (3-0) S
(See economics, page 287.)

ST 571 (BMA 571, MA 571) BIOMATHEMATICS I 3 (3-0) F
(See biomathematics, page 253.)

ST 572 (BMA 572, MA 572) BIOMATHEMATICS II 3 (3-0) S
(See biomathematics, page 253.)

ST 581 INTRODUCTION TO NONPARAMETRIC STATISTICS 3 (3-0) F
Prerequisite: ST 522

This course will treat both theoretical and methodological material relevant to inference problems arising when sampling is from a parent family that is not assumed to have a particular functional form. Most of the course will be devoted to inference problems for the absolutely continuous family of distributions. (Offered fall, 1972 and alternate years.) Mr. Quesenberry

ST 583 INTRODUCTION TO STATISTICAL DECISION THEORY 3 (3-0) F
Prerequisite: ST 522

The theory of statistical inference will be discussed from a unified decision theoretic point of view and its relationship with the zero-sum two person game will be studied. Detailed attention will be paid to the development of techniques of statistical analysis using Bayesian approach. The major emphasis in the course will be directed towards the solution of problems using decision theoretic concepts. (Offered fall, 1971 and alternate years.) Mr. Bhattacharyya

ST 591 SPECIAL PROBLEMS 1-3 F S
Development of techniques for specialized cases, particularly in connection with thesis and practical consulting problems. Staff

FOR GRADUATES ONLY

ST 606 (MA 606, OR 606) MATHEMATICAL PROGRAMMING II 3 (3-0) S

ST 613	TIME SERIES ANALYSIS I	3 (3-0) S
ST 614	TIME SERIES ANALYSIS II	3 (3-0) F
ST 617, 618 (MA 617, 618)	MEASURE THEORY AND ADVANCED PROBABILITY	3 (3-0) F S
ST 619 (MA 619)	TOPICS IN ADVANCED PROBABILITY	3 (3-0) Sum.
ST 621	STATISTICS IN ANIMAL SCIENCE	3 (3-0) F
ST 622 (ANS 622)	PRINCIPLES OF BIOLOGICAL ASSAYS	3 (3-0) S
ST 623	STATISTICS IN PLANT SCIENCE	3 (3-0) F
ST 626 (GN 626)	STATISTICAL CONCEPTS IN GENETICS	3 (3-0) S
ST 631	THEORY OF SAMPLING APPLIED TO SURVEY DESIGN	3 (3-0) F
ST 637	ADVANCED STATISTICAL INFERENCE	3 (3-0) S
ST 641 (SOC 641)	STATISTICS IN SOCIOLOGY	3 (3-0) S
ST 651 (EC 651)	ECONOMETRICS	3 (3-0) F
ST 652 (EC 652)	TOPICS IN ECONOMETRICS	3 (3-0) S
ST 671	ADVANCED ANALYSIS OF VARIANCE AND VARIANCE COMPONENTS	3 (3-0) F
ST 672	SPECIAL ADVANCED TOPICS IN STATISTICAL ANALYSIS	3 (3-0) S
ST 674	ADVANCED TOPICS IN CONSTRUCTION AND ANALYSIS OF EXPERIMENTAL DESIGNS	3 (3-0) S
ST 682	STATISTICAL ANALYSIS FOR LINEAR MODELS	3 (3-0) F
ST 691	ADVANCED SPECIAL PROBLEMS	1-3 F S
ST 694	SEMINAR	1 (1-0) F S
ST 699	RESEARCH	Credits Arranged F S

TEXTILE CHEMISTRY

FOR UNDERGRADUATES

TC 203	FIBER SCIENCE I	3 (3-0) FS
Prerequisite: CH 103 or CH 107		

A lecture course emphasizing: the chemical constitution and properties of fiber-forming polymers; theories of fiber structure; the relationship between the molecular structure of linear polymers and physical properties of natural and man-made fibers; the principles and methods for producing man-made fibers; the chemical behavior of natural and man-made fibers.

Mr. Rutherford

TC 301 TECHNOLOGY OF DYEING AND FINISHING**5 (4-2) FS****Prerequisites:** TC 203, TX 250

A comprehensive course designed to familiarize the textile technology student with the basic principles involved and the procedures used for the preparation, dyeing, printing and finishing of natural and man-made fibers. Some emphasis is placed upon the chemical nature of dyes and fastness properties, and the chemical nature of finishes used to impart specific end-use properties.

Messrs. Guion, Hayes, Livengood**TC 303 TEXTILE CHEMISTRY III****4 (3-3) S****Prerequisite:** CH 223

A study of the action of chemicals on fibers; scouring, bleaching, mercerization and dyeing of textile materials; preparation of typical dyestuffs and their application to natural and man-made fibers.

Mr. Hayes**TC 400 THE SCIENCE OF COLOR****3 (3-0) F****Prerequisite:** Junior standing

The course is designed to acquaint the student with the physical concepts of color. The colorimetric and spectrophotometric methods of measuring color, the correlation of results with the subjective, physiological perception of color, and the principles of modern instrumental color matching are presented.

Mr. Goldfinger**TC 401 SOURCES AND CONTROL OF POLLUTION FROM THE TEXTILE INDUSTRY****3 (3-0) S****Prerequisite:** Consent of instructor

The course content includes a) the concept of water quality management, b) parameters of pollution, c) sources of pollution from fabric wet-processing, d) plant surveys and in-plant remedial measures, e) principles of biological oxidation, f) current waste-treatment practices and g) new developments and trends in pollution control. While the emphasis is on wastes from the textile industry, the student is introduced to the broader aspects of environmental pollution. Lectures from outside specialists in waste control, visits to nearby waste-treatment plants, and several periods of laboratory demonstrations supplement the course.

Mr. Bryan**TC 403, 404 TEXTILE CHEMICAL TECHNOLOGY****3 (3-0) FS****Prerequisites:** (403) TC 303, CH 223

Basic principles are applied to the study of three important areas of textile processing: dyeing, printing and finishing. These areas are concerned with the chemical nature of dyes and other chemical agents applied to fibrous systems; with the chemical and physical properties of the various fibers; and with the mechanical aspects of the application of chemical materials to fibers and fabric. The course includes: an extensive review of the various classes of dyes and their application to all important textile fibers and blends of fibers; a comparative analysis of dyeing machinery and processes involving special machinery and equipment; a survey of modern preparatory and bleaching methods for all important fibers; a study of the roller printing machine, and the principles involved in print formulations for the major classes of dyes and their application to the various fibers; a study of important mechanical, additive and chemical modification type finishes for fabric.

Mr. Campbell**TC 405, 406 TEXTILE CHEMICAL TECHNOLOGY LABORATORY****2 (0-6) FS****Prerequisites:** TC 403, TC 404

To be taken concurrently with TC 403, TC 404.

TC 411 TEXTILE CHEMICAL ANALYSIS I**3 (2-2) F****Prerequisite:** TC 301

The work includes a survey of textile chemicals, with emphasis on surfactants.

warp sizes and fabric finishes of all types; the identification of fibers by chemical means; the qualitative and quantitative analysis of fiber blends by chemical means, the identification of finishes; the evaluation techniques for dyed and finished materials. (Not available for students majoring in textile chemistry.)

Mr. Livengood

TC 412 TEXTILE CHEMICAL ANALYSIS II

3 (2-3) S

Prerequisite: CH 315

Application of certain techniques of analysis to fibers, textile chemicals and textile processes: ultraviolet, visible and infrared spectrophotometry; thin-layer and gas chromatography, viscometry; interfacial tension; calorimetric, gravimetric and mechanical thermal analyses. Emphasis on use of these techniques to solve problems of analysis involving such processes as sorption, solution, diffusion, crystallization, etc.

TC 461 (CH 461) CHEMISTRY OF FIBERS

3 (3-0) F

Prerequisite: CH 223

A lecture course emphasizing: the formation and properties of fiber-forming polymers; mechanism of addition and condensation polymerization; theories of fiber structure, the relationship between the chemical structure and physical properties of natural and man-made fibers; the production of man-made fibers.

Messrs. Gilbert, Rutherford

TC 490 SPECIAL TOPICS IN TEXTILE CHEMISTRY

1-3 FS

Prerequisites: Consent of instructor

Special topics relating to current developments in textile and polymer chemistry.
Staff

TC 491 SEMINAR IN TEXTILE CHEMISTRY

1 (0-2) S

Prerequisite: TC 403

The course is designed to familiarize the student with the principal sources of textile chemical literature and to emphasize the importance of keeping abreast of developments in the field of textile chemistry. Particular attention is paid to the fundamentals of technical writing. Reports. Lectures arranged. Mr. Campbell, Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

TC 505 THEORY OF DYEING

3 (3-0) FS

Prerequisite: CH 433

Mechanisms of dyeing. Applications to dyeing systems. Kinetics of diffusion in dyeing processes.
Mr. Guion, Staff

TC 561 ORGANIC CHEMISTRY OF HIGH POLYMERS

3 (3-0) S

Prerequisite: TC 461, CH 331 or CH 431

Principles of step- and chain-growth polymerizations; co-polymerization theory; homogeneous free radical polymerization; emulsion polymerization; Ziegler-Natta polymerization; ionic polymerization; high resolution and broadline nmr spectroscopy of polymers.
Messrs. Gilbert, Theil

TC 562 (CH 562) PHYSICAL CHEMISTRY OF HIGH POLYMERS—BULK PROPERTIES

3 (3-0) F

Prerequisites: CH 220 or CH 223; CH 331 or CH 431

Kinetics and molecular weight description; states of aggregation and their interconversion; rubbery, glassy and crystalline states; mechanical properties; diffusional properties.
Messrs. Cates, Walsh

FOR GRADUATES ONLY

TC 662	PHYSICAL CHEMISTRY OF HIGH POLYMERS—SOLUTION PROPERTIES	3 (3-0) S
TC 671 (CHE 671)	SPECIAL TOPICS IN POLYMER SCIENCE	1-3 F
TC 691 (TX 691)	SPECIAL TOPICS IN FIBER SCIENCE	1-3 S
TC 698	SEMINAR FOR TEXTILE CHEMISTRY	1 (1-0) FS
TC 699	TEXTILE RESEARCH FOR TEXTILE CHEMISTRY	Credits Arranged

TEXTILE TECHNOLOGY

FOR UNDERGRADUATES

TX 211	FIBER SCIENCE II	3 (2-2) F S
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Prerequisites: TC 203, MA 212 or MA 202

A presentation of the physical properties of textile raw materials as related to type of fibers and chemical structure. Typical areas of discussion are parameters used to describe textile fibers, classification in terms of quality factors, their reactions to moisture, stress-strain properties, method of measuring physical properties covered in Fiber Science I, and relationship between polymer structure, fiber properties and their utilization as single fiber composites or blends of fibers.

Mr. Hutchison

TX 220	YARN FORMING SYSTEMS	4 (3-2) F S
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Prerequisite: T 101 or equivalent

A study of the principles of staple and filament yarn systems and structures. The influence of the manufacturing system and the input materials on product characteristics is established.

Staff

TX 250	FABRIC FORMING SYSTEMS	4 (3-2) F S
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Prerequisite: TX 220

A study of the basic fabric-forming systems, including nonconventional, weaving and knitting. Emphasis is on fabric construction and geometry. Structures of fabric and resulting properties are related to raw materials and product performance.

Staff

TX 271	UPHOLSTERY FABRICS	2 (2-0) S
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A study of the basic principles of textile manufacturing and structure of woven fabrics, identification of classic decorative fabrics used for upholstered furniture coverings, with emphasis on nomenclature and physical properties and textile trade customs.

Mr. Porter, Jr.

TX 300	GENERAL MICROSCOPY	3 (1-4) F
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Prerequisite: PY 212

The art and science of light microscopy and introduction to electron microscopy and microradiography; theoretical and practical aspects of visibility, resolution and contrast. Laboratory practice in assembly, testing and using various microscopes and accessories in describing, identifying and photomicrographing crystal-

line, oriented or amorphous materials which are used in the textile, fabric, plastic and agricultural industries and in the life sciences. Messrs. Gupta, Rochow

TX 320 DESIGN AND CONTROL OF STAPLE YARN SYSTEMS 5 (4-2) F S

Prerequisite: TX 220

Corequisite: TX 211

A discussion of the technological and economic aspects of staple yarn forming systems. Topics to be included are fiber-machine interactions, the use of automated systems and processes, the blending of similar and dissimilar textile fibers and the control of the overall manufacturing operation to yield products with designed characteristics. Staff

TX 330 TEXTILE MEASUREMENTS AND QUALITY CONTROL 4 (3-2) F S

Prerequisites: TX 250, ST 361

Principles of measuring basic physical properties of textile materials, techniques of in-process control and evaluation of finished product quality; application to the manufacturing sequence, of statistical control charts and capability limits, aspects of sampling theory. Staff

TX 340 PRINCIPLES OF KNITTED FABRIC STRUCTURES 5 (4-2) F S

Prerequisites: TX 211, TX 250

Warp and weft knit fabrics, their properties, end uses and production as related to current trends and developments in fabrics and machines. The principles of design and fabric geometry as a basis for performance, quality and costing. Finishing and its effect on fabric properties. Staff

TX 350 WOVEN FABRIC STRUCTURES 5 (4-2) F S

Prerequisites: TX 211, TX 250

A study of performance characteristics of woven structures as related to properties of raw materials, fabric structure and methods of production. The utilization of modern control systems to optimize the systems involved in the production of woven fabrics. Staff

TX 380 MANAGEMENT AND CONTROL OF TEXTILE SYSTEMS 3 (3-0) F S

Prerequisites: EC 206, TX 250

The principles and techniques of controlling the process of converting staple fibers or filament yarns into industrial and consumer products as viewed from the standpoint of the process decision maker. Mr. Cooper

TX 405 NONCONVENTIONAL FABRIC STRUCTURES 3 (3-0) F

Prerequisites: Senior standing, consent of instructor

An advanced study of systems for the direct conversion of fiber to fabrics. The total spectrum of possible fabric structure is surveyed and classified. Current marketable structures are analyzed with respect to production technologic, economic, and property potential. Trends in direct conversion technology are discussed in detail to provide the student with a viable basis for participating in the evolution of the technology and its production. Messrs. George, Porter, Jr.

TX 425 CONTINUOUS FILAMENT YARN SYSTEMS 3 (2-2) F S

Prerequisites: TX 211, TX 220

A study of the structure of thermoplastic polymers in continuous filament form and their response to elevated temperatures, high velocity air flow and other methods of modification to produce bulked, textured and torque type yarns. A fundamental study of related properties such as stress relaxation, generation and control of electrostatic charges and responses to low order tensile forces.

Mr. Tucker, Jr.

TX 426 LONG STAPLE AND TOW SYSTEMS**3 (2-2) F S****Prerequisites:** TX 211, TX 220

Principles of long staple yarn-forming systems including the woolen, worsted, tow to top, and compact carpet yarn systems. Emphasis is on the relationship of fiber structures and characteristics necessary to produce the desired properties and performance characteristics of such yarns as woolen and worsted blends with man-made fibers, bulked yarns and carpet yarns.

Mr. Pardue**TX 431 SPECIAL TOPICS IN TESTING****3 (2-2) S****Prerequisites:** TX 330, senior or graduate standing

A topical presentation of special and advanced techniques for measuring selected physical and aesthetic properties of natural and man-made textile materials; application of the physical law to technique and instrumentation; interrelation of the material, method of test, instrumentation involved and the resulting physical measure.

Mr. Stuckey**TX 441 ADVANCED WEFT KNITTING****3 (2-2) F****Prerequisite:** TX 340

A study of advanced weft knit mechanisms and fabrics. The development of new fabrics for specific end uses.

Staff**TX 444 GARMENT MANUFACTURE****3 (2-2) S****Prerequisite:** TX 340

A study of circular latch needle and spring needle machines for knitted fabric production. Styling, cutting and seaming of the basic garment types for underwear and outerwear; standard seam types; high-speed sewing machines.

Staff**TX 447 ADVANCED DESIGN OF KNITTING STRUCTURES****2 (0-4) F S****Prerequisite:** TX 340

A study of the principles of design of knit structures and garments, needle selecting mechanisms, their scope and uses. Modern developments in selecting mechanisms. Economics of jacquard fabrics. Production scheduling. Quality control in jacquard knitting.

Staff**TX 449 WARP KNITTING SYSTEMS****3 (2-2) S****Prerequisite:** TX 340

A critical study of tricot, raschel, simplex and milanese machines. The emphasis will be on principles of production including quality and costing, and the limitations of each method will be discussed. The fabric properties will be related to end uses, and both recent developments and future trends will be discussed in terms of improvements in yarns and mechanisms. Fabric design and analysis will receive attention.

Staff**TX 450 ADVANCED DESIGN AND WEAVING****3 (2-2) F S****Prerequisite:** TX 350

Advanced study of special weave formations and of new developments and research findings in the areas of warp preparation, design weaving and fabric formation.

Mr. Moser**TX 451 COMPLEX WOVEN STRUCTURES****3 (2-2) S****Prerequisite:** TX 450

The development of design specifications for complex fabrics as related to fabric geometry, functional and aesthetic properties and manufacturing limitations.

Staff

TX 460 PHYSICAL PROPERTIES OF TEXTILE FIBERS 3 (3-0) F S
 Prerequisites: MA 212, PY 212

The course covers the structural, mechanical, thermal, optical, frictional and electrical properties, and the effect of moisture on physical and mechanical properties. The influence of these properties on the utility and the scope of the fibers as related to performance. Mr. Gupta

TX 465 MECHANICS OF YARN FORMATION 3 (2-2) F
 Prerequisite: TX 320

Theoretical analysis of machine-fiber interaction is studied for such functions as fiber blending, the carding actions, staple fiber attenuation, and spun yarn formation. Laboratory experiments are designed to verify the analyses discussed in the lecture. Mr. El-Shiekh

TX 480 TEXTILE COST CONTROL 3 (3-0) F S
 Prerequisites: TX 320, TX 350, EC 206

A study of cost methods applicable to textile costing with emphasis on decision-making. Interpretation of cost reports and their use in pricing and cost control. Mr. Powell

TX 482 (EC 482) SALES MANAGEMENT FOR TEXTILES 3 (3-0) S
 Prerequisite: TX 380

Definition and analysis of the role of sales management in the textile industry. Areas of control and responsibility are reviewed. Analytical tools of sales management are studied and through case methods are brought into practical focus for the student. Mr. Cooper

TX 484 MANAGEMENT DECISION MAKING FOR THE TEXTILE FIRM 3 (3-0) S
 Prerequisite: TX 482 (EC 482)

A study of the economic and environment setting within which the textile firm makes decisions, and an application of various analytical tools, quantitative and qualitative in making these decisions. Strategies for implementing these decisions are explored. Mr. Cooper

TX 490 DEVELOPMENT PROJECT IN TEXTILE TECHNOLOGY 2-3 F S
 Prerequisites: Senior standing, consent of instructor

Introduction to research through experimental, theoretical and literature studies of textile and related problems. Staff

TX 491 SPECIAL TOPICS IN TEXTILES 1-3 F S
 Prerequisite: Senior standing

Special topics relating to current developments in the textile industry. Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

TX 500 ADVANCED MICROSCOPY 3 (1-4) S
 Prerequisite: TX 300 or consent of instructor

The art and science of light and electron microscopy and introduction to micro-radiography; theoretical and practical aspects of visibility resolution and contrast. Laboratory practice in assembly, testing and using various microscopes and accessories in describing, identifying and micrographing crystalline, oriented or amorphous materials, especially those which are of interest to the student. Laboratory work may include special projects for independent investigations.

Messrs. Gupta, Rochow

TX 530 TEXTILE QUALITY CONTROL 3 (3-0) S
Prerequisite: TX 330 or consent of instructor

Quality control systems for textile operations with emphasis on sampling plans for attributes and variables and on interpretation of data as related to identifying sources of product variability. Mr. Stuckey

TX 550 FABRIC ANALYTICS 3 (3-0) F S
Prerequisite: TX 350 or graduate standing

Development of a numerical system for characterizing designs. Permutations and combinations of weave elements. Correlation of fiber and yarn properties with those of the fabric. Engineering design of fabrics. Relationships between fabrics having geometrical similarity and the prediction of their physical properties. Mr. Bogdan

TX 560 STRUCTURAL AND PHYSICAL PROPERTIES OF FIBERS 3 (3-0) F
Prerequisite: MA 301

Advanced study of the structural and physical properties (including thermal, optical, frictional and electrical) of textile fibers. Theoretical relations and advanced techniques are presented and discussed. Mr. Gupta

TX 561 MECHANICAL AND RHEOLOGICAL PROPERTIES OF FIBROUS MATERIAL 3 (2-2) S
Prerequisite: MA 301

In-depth study of the stress-strain, bending torsional dynamic and rheological behavior of natural and man-made fibers. Theoretical relations and advanced techniques are presented and discussed. Mr. Gupta

TX 585 (EC 585) MARKET RESEARCH IN TEXTILES 3 (3-0) S
Prerequisites: MA 405, ST 421

A study and analysis of the quantitative methods employed in market research in the textile industry. The function of market research and its proper orientation to management and decision-making. Mr. Cooper

TX 590 SPECIAL PROJECTS IN TEXTILES 2-3 F S
Prerequisites: Senior or graduate standing, consent of instructor

Special studies in either the major or minor field of the advanced undergraduate or graduate student. These studies will include current problems of the industry, independent investigations, seminars and technical presentations, both oral and written. Graduate Staff

TX 591 SPECIAL TOPICS 1-4 F S
Prerequisite: Consent of instructor

An intensive treatment of selected topics involving textile technology. Graduate Staff

TX 598 TEXTILE TECHNOLOGY SEMINAR 2 (2-0) S
Prerequisites: Senior standing, consent of instructor

Lecture and discussion of current topics relating to the textile industry. Graduate Staff

FOR GRADUATES ONLY

TX 601 STAPLE FIBER STRUCTURES I 3 (2-2) F

TX 602 STAPLE FIBER STRUCTURES II 3 (2-2) FS

TX 621 TEXTILE TESTING III 2 (2-0) S

TX 631	SYNTHETIC FIBERS	2 (1-2) FS
TX 641, 642	ADVANCED KNITTING SYSTEMS AND MECHANISMS	3 (3-0) FS
TX 643, 644	KNITTING TECHNOLOGY	3 (1-4) FS
TX 651, 652	FABRIC DEVELOPMENT AND CONSTRUCTION	3 (1-4) FS
TX 663 (MAE 663)	MECHANICS OF TWISTED STRUCTURES	3 (3-0) F
TX 664 (MAE 664)	MECHANICS OF FABRIC STRUCTURES	3 (3-0) S
TX 691 (TC 691)	SPECIAL TOPICS IN FIBER SCIENCE	1-3 S
TX 698	SEMINAR	1 (1-0) FS
TX 699	TEXTILE RESEARCH	Credits Arranged

TEXTILES (General Courses)

T 101	FUNDAMENTALS OF TEXTILES	2 (1-2) F S
<p>An introduction to textiles, including the history of the industry, description of textile materials and products and their utilization. Presentation of the basic manufacturing systems, materials flow, terminology and calculations.</p>		
		Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES

T 501	RESINOGRAPHY	3 (1-4) FS
<p>Prerequisites: TX 300 or TX 500 and TX 460 or TX 560 or TC 461</p>		
<p>Lectures, laboratory and discussion regarding structure and morphology of resins, fibers, elastomers and composites. Such materials will be studied by reflected light or electrons and by transmitted light or electrons. Other methods of diffraction and spectrometry will be discussed. Crystallographic and optical properties will be emphasized.</p>		
		Mr. Rochow

UNIVERSITY STUDIES

FOR UNDERGRADUATES

UNI 303	MAN AND HIS ENVIRONMENT	3 (2-1) F
<p>Prerequisite: Sophomore standing</p>		
<p>An examination of the growing interaction between man and his global environment. Attention will be directed to the fundamental concepts of ecology, the impacts of technology upon the contemporary world environment, the broad, humanistic aspects of our present environmental problems and the need for new institutional arrangements in both government and the university as an aid to their solution. Two lectures and one discussion section each week.</p>		
UNI 323	THE WORLD POPULATION AND FOOD CRISIS	3 (2-1) S
<p>Prerequisite: Sophomore standing</p>		
<p>An inter-disciplinary analysis of United States and world population growth in</p>		

connection with national and world food requirements and man's place in the ecology of the earth. Attention will be given to the complex issues of population growth in both developed and developing nations in light of United States policies and programs. Controversial proposals will be discussed and evaluated. Two lectures and one discussion section each week.

SS 301 SCIENCE AND CIVILIZATION

3 (3-0) F S

Prerequisite: Sophomore standing

An examination of the emergence of a distinctively modern world-view in the West from the 13th to the 20th centuries. This course covers in some detail the scientific revolutions of the 17th to the 20th centuries in order to demonstrate the interrelatedness of scientific, social and aesthetic activity.

SS 302 SCIENCE AND CONTEMPORARY CIVILIZATION

3 (3-0) F S

Prerequisite: Sophomore standing

This course explores the chief revolutionary developments in 20th century science and briefly traces some intellectual consequences of these developments. Areas of investigation include contemporary social theory, psychology, philosophy and theology.

SS 401 CONTEMPORARY ISSUES: THE URBAN CRISIS

3 (3-0) F

Prerequisite: Junior standing

A discussion of domestic urban issues, particularly those which have resulted from the impact of technology. The course examines the change from a rural to an urban society, and considers such resulting problems as poverty in affluence, racial tensions and changes in the environment. Controversial proposals will be discussed. Course materials may include newspapers as well as texts.

SS 402 CONTEMPORARY ISSUES: THE ARMS RACE

3 (3-0) S

Prerequisite: Junior standing

A discussion of international issues facing the United States, particularly those which reflect the impact of the new technology. This course begins with an examination of the revolution of modern weaponry, and moves on to a discussion of the cold war and the consequences of the world arms race for the underdeveloped as well as the industrialized world. Selected areas of current interest will be examined in the light of the framework developed. Controversial positions will be discussed in lecture and section meetings. Course materials include current newspapers as well as texts.

URBAN DESIGN

UD 501 INTRODUCTORY PROBLEMS IN URBAN DESIGN

3 (0-6) F

Prerequisite: Graduate standing

Introduction to descriptive analysis of physical and socio-economic phenomena of urban environments, and application of research methods in the definition and resolution of urban design problems.

Mr. Batchelor

UD 502 URBAN DESIGN WORKSHOP I

3 (0-6) S

Prerequisite: UD 501

Complete synthesis of design factors influencing an environmental system or an urban complex.

Mr. Batchelor

UD 520 THEORY AND PRINCIPLES OF URBAN DESIGN

3 (3-0) S

Prerequisite: Graduate standing

An examination of the nature of the design process in urban environments with special emphasis on contemporary theory and practice.

Staff

UD 590 SPECIAL TOPICS IN URBAN DESIGN I 1-6 FS
Prerequisite: Fourth year standing

This course provides a flexible means for investigation into areas of special interest related to urban design. It is intended primarily to encourage independent study and research. Staff

UD 595 ENVIRONMENTAL PERCEPTION 3 (3-0) S
Prerequisite: Graduate standing

The course is designed to acquaint the student with the theories and research on the perception of urban environments. Emphasis is placed on the visual attributes as well as user perceptions of the environment with a focus on the structuring of research to explore these dimensions. Staff

FOR GRADUATES ONLY

UD 601 URBAN DESIGN WORKSHOP II 6 (0-12) F

UD 602 ADVANCED PROBLEMS IN URBAN DESIGN 6 (0-12) S

UD 610 THEORY OF URBAN FORM 3 (3-0) S

UD 690 SPECIAL TOPICS IN URBAN DESIGN II 1-6 FS

WOOD AND PAPER SCIENCE AND TECHNOLOGY

FOR UNDERGRADUATES

WPS 101 (FOR 101) INTRODUCTION TO FOREST RESOURCES 1 (1-0) F
(See forestry, page 320.)

WPS 201 WOOD STRUCTURE AND PROPERTIES 3 (2-3) S
Identification, structure, properties and uses of woods of economic importance in the United States. This course is a condensation of WPS 202, WPS 203 with less emphasis. Mr. Carter

WPS 202 WOOD STRUCTURE AND PROPERTIES I 3 (2-3) F
Prerequisite: BS 100 or BO 200

The macrostructure and microstructure of wood is emphasized in this introductory course. As related to wood structure, the physical properties and uses of several commercially important coniferous and deciduous woods are also studied. The techniques of hand lens and microscope identification of wood are covered. Mr. Thomas

WPS 203 WOOD STRUCTURE AND PROPERTIES II 3 (2-3) S
Prerequisites: WPS 202, PY 211

Physical properties of wood, specific gravity relationships, wood in relation to moisture, wood in relation to heat, sound, light, electricity, combustion; introduction to strength properties of wood. Mr. Hart

WPS 205 WOOD MACHINING PRACTICUM 1 Sum.
Prerequisite: WPS 201 or WPS 202
Sophomore Summer Practicum

Laboratory exercises in machining of wood. Staff

WPS 206	WOOD DRYING PRACTICUM	1 Sum.
Prerequisite: WPS 201 or WPS 202		
Sophomore Summer Practicum		
	Laboratory exercises in wood drying.	Staff
WPS 207	GLUING PRACTICUM	1 Sum.
Prerequisite: WPS 201 or WPS 202		
Sophomore Summer Practicum		
	Laboratory exercises in gluing wood and preparation of particle board.	Staff
WPS 208	WOOD FINISHING PRACTICUM	1 Sum.
Prerequisite: WPS 201 or WPS 202		
Sophomore Summer Practicum		
	Laboratory exercises in wood finishing.	Staff
WPS 209	PLANT INSPECTIONS	1 Sum.
Prerequisites: WPS 201 or WPS 202		
	Inspection of wood-using plants.	Staff
WPS 210	FOREST PRODUCTS INTERNSHIP	1
Prerequisite: Completion of summer practicum		
This course provides experience in the forest products or related industries under a program through which the student is assigned problem solving in an industrial situation to provide him with some insight of forest products technology. Students are expected to write a paper on their experience.		
WPS 219 (FOR 219)	FOREST ECONOMY AND ITS OPERATION	3 (2-2) F
(See forestry, page 321.)		
WPS 273 (FOR 273)	QUANTITATIVE METHODS IN FOREST RESOURCES	3 (2-2) FS
(See forestry, page 321.)		
WPS 301	WOOD PROCESSING I	3 (2-2) F
Prerequisites: WPS 201 or WPS 202 and summer practicum		
The processes of drying, gluing and finishing wood. Processes of reconstituting wood as fiberboard, hardboard and particle board. Basic requirements of various procedures and materials. Factors in selecting production methods.		
		Mr. Carter
WPS 302	WOOD PROCESSING II	3 (2-3) S
Prerequisites: WPS 201 or WPS 202 and summer practicum		
The theories and techniques of converting raw wood into usable products by milling, veneering and chipping round wood. Included also is the processing of finished lumber, dimension stock, plywood and other wood products.		
		Mr. Carter
WPS 319 (PP 319)	BIOLOGICAL DETERIORATION OF WOOD	1 (2-3) S
(See plant pathology, page 408.)		
WPS 320	WOOD PRODUCTS CHEMISTRY	3 (2-3)
Prerequisite: CH 103		
A general description of the chemical and physico-chemical properties of wood followed by an introduction to the chemical principles of the processes involved in wood products industry including pulp manufacture for paper and fiber board, wood adhesion and lamination, wood finishing, wood preservation, wood drying and dimensional stabilization.		

- WPS 321, 322 PULP AND PAPER TECHNOLOGY** 3 (3-0) F S
 Brief survey of the physical and chemical characteristics of wood and cellulose. Chemistry and technology of the major mechanical, chemical and semichemical processes employed in the manufacture of pulp and paper. Mr. Hitchings
- WPS 342 FIBER ANALYSIS** 3 (1-4) S
 Fiber microscopy; the determination of fiber measurement, quality, variation and identity in pulpwood. Mr. Barefoot
- WPS 403 PAPER PROCESS ANALYSIS** 3 (0-6) S
 Manufacture of several types of papers with particular attention to stock preparation, sizing, filling and coloring. The finished products are tested physically and chemically and evaluated from the standpoint of quality and in comparison with the commercial products they are intended to duplicate. Mr. Hitchings
- WPS 411, 412 PULP AND PAPER UNIT PROCESSES** 3 (3-0) F S
 Principles of operation, construction and design of process equipment employed in the pulp and paper industry. Mr. Rogers
- WPS 413 PAPER PROPERTIES AND ADDITIVES** 4 (1-9) F
 Physical, chemical and microscopical examination of experimental and commercial papers and evaluation of the results in terms of the utility of the product tested; evaluation and identification of dyestuffs and the development of color formulas. Mr. Landes
- WPS 423 (FOR 423) LOGGING AND MILLING** 3 (2-3) F
 Analysis of timber harvesting and transportation systems, equipment selection and costs; safety and supervision; manufacturing methods; log and lumber grades; analysis of investment alternatives. Mr. Mullin
- WPS 434 WOOD OPERATIONS I** 3 (2-3) F
 Prerequisites: WPS 301, WPS 302
 Organization of manufacturing plants producing wood products, including company organization, plant layout, production planning and control. Analysis of typical manufacturing operations in terms of processes, equipment, size and product specification. The organization and operation of wood products markets. Mr. Carter
- WPS 435 (FOR 435) SYSTEMS ANALYSIS IN FOREST PRODUCTS** 3 (3-0) S
 Prerequisite: Senior standing
 The application of the techniques of operations analysis to management decision-making in the wood products field. Allocation of production resources, inventory of raw materials, scheduling of production activities and general problems of quantitative decision-making. Mr. Hafley
- WPS 344 INTRODUCTION TO QUALITY CONTROL** 3 (2-1) S
 Prerequisite: ST 361
 A study of methods used to control quality of manufactured wood products. Control charts of variables and attributes. Acceptance sampling techniques. Mr. Barefoot
- WPS 441 INTRODUCTION TO WOOD MECHANICS** 2 (2-0)
 Prerequisite: MA 212, PY 221 or PY 211
 Strength and related properties of commercial woods; standard A.S.T.M. strength tests; toughness; timber fastening; design of columns; simple, laminated and box beams; trusses and arches. Mr. Pearson

WPS 442 WOOD MECHANICS AND DESIGN**3 (2-3)****Prerequisite:** EM 211 or WPS 441

The course will provide an understanding of wood as an engineering material. Topics include—generalized Hooke's law for orthotropic bodies and the effect of orientation of applied forces relative to the axes of symmetry; mechanical properties of wood as affected by its cellular structure; influence of defects, moisture, temperature and duration of load; visual and mechanical grading; derivation of working stresses; glued laminated construction; structural plywood; design of wooden members.

WPS 461 PAPER CONVERTING**1 (1-0) S**

A survey of the principal processes by which paper and paper board are fabricated into the utilitarian products of everyday use.

Mr. Landes**WPS 463 PLANT INSPECTIONS****1 (0-3) S**

One-week inspection trips covering representative manufacturers of pulp and paper and paper-making equipment.

Staff**WPS 471 PULPING PROCESS ANALYSIS****4 (1-9) F**

Preparation and evaluation of the several types of wood pulp. The influence of the various pulping and bleaching variables on pulp quality are studied experimentally and these data evaluated critically.

Mr. Hitchings**WPS 481 PULPING PROCESSES AND PRODUCTS****2 (2-0) S****Prerequisites:** WPS 202, CH 103

Technology and economics of pulp products and by-products, including: paper and paperboard, containers and boxes, structural boards, molded and laminated products, cellulose fibers and films, cellulose derivatives and silvichemicals.

Mr. Landes**WPS 482 PULP AND PAPER MILL MANAGEMENT****2 (2-0) S**

A survey of decision-making processes in pulp and paper mill management. A study of quantitative decision-making processes appropriate to various mill departments and functions.

Staff**WPS 491 (FOR 491) SENIOR PROBLEMS IN FOREST RESOURCES****Credits Arranged****Prerequisite:** Consent of department

Problems selected with faculty approval in the areas of management or technology.

Staff**WPS 492 (FOR 492) SENIOR PROBLEMS IN FOREST RESOURCES****Credits Arranged****Prerequisite:** Consent of department

Problems selected with faculty approval in the areas of management or technology.

Staff**FOR GRADUATES AND ADVANCED UNDERGRADUATES****WPS 513 TROPICAL WOODS****2 (1-3) F****Prerequisites:** WPS 203, WPS 301

Structure, identification, properties, characteristics and use of tropical woods, especially those used in plywood and furniture.

Mr. Barefoot**WPS 521, 522 CHEMISTRY OF WOOD AND WOOD PRODUCTS****3 (2-3) F S****Prerequisites:** CH 315, CH 331, WPS 202, PY 212

Fundamental chemistry and physics of wood and wood components; pulping principles; electrical and thermal properties.

Mr. Kringstad

WPS 525 POLLUTION ABATEMENT IN FOREST PRODUCTS INDUSTRIES 3 (3-0) S
 Prerequisite: Graduate or advanced undergraduate standing in science or engineering curricula

The course will deal with pollution sources, inplant control and treatment of water and air pollution in forest products. In the main, the course will concentrate upon inplant pollution control in the pulp and paper industry. Staff

WPS 533 ADVANCED WOOD STRUCTURE AND IDENTIFICATION 2 (1-3) F
 Prerequisite: WPS 202

Advanced microscopic identification of the commercial woods of the United States and some tropical woods; microscopic anatomical features and laboratory techniques. Mr. Barefoot

WPS 591 (FOR 591) WOOD AND PAPER SCIENCE PROBLEMS Credits Arranged
 Prerequisite: Senior or graduate standing

Assigned or selected problems in the field of silviculture, logging, lumber manufacturing, pulp technology or forest management. Staff

WPS 599 (FOR 599) METHODS OF RESEARCH IN WOOD AND PAPER SCIENCE Credits Arranged
 Prerequisite: Senior or graduate standing

Research procedures, problem outlines, presentation of results; consideration of selected studies by forest research organizations; sample plot techniques. Staff

FOR GRADUATES ONLY

WPS 604 TIMBER PHYSICS 3 (3-0) F S

WPS 605 DESIGN AND CONTROL OF WOOD PROCESSES 3 (3-0) F S

WPS 606 WOOD PROCESS ANALYSIS 3 (3-0) F

WPS 607 ADVANCED QUALITY CONTROL 3 (3-0) S

WPS 691 (FOR 691) GRADUATE SEMINAR 1 (1-0) F S

WPS 693 ADVANCED WOOD TECHNOLOGY PROBLEMS Credits Arranged

WPS 699 (FOR 699) PROBLEMS AND RESEARCH Credits Arranged

ZOOLOGY

FOR UNDERGRADUATES

BS 100 GENERAL BIOLOGY 4 (3-2) F S
 (See biological sciences, page 252.)

ZO 201 ANIMAL LIFE 4 (3-3) F S
 Prerequisite: BS 100

The biology of the major groups of animals, with emphasis on general structural plans and diversity, reproduction, development, ecology, behavior and evolution. Mr. Martof, Mrs. Bradbury

- ZO 221 CONSERVATION OF NATURAL RESOURCES 3 (3-0) F S
Prerequisite: BS 100
The importance of natural resources to man and the part they play in his environment. The physical, biological and ecological principles underlying natural resource conservation with particular attention given to the biological consequences of overexploitation and environmental pollution. Mr. Barkalow
- ZO 223 COMPARATIVE ANATOMY 4 (2-4) F S
Prerequisite: ZO 201 or consent of instructor
A comparative morphology of vertebrates demonstrating the interrelationships of the organ systems of the various groups. Mr. Harkema
- ZO 315 GENERAL PARASITOLOGY 3 (2-3) S
Prerequisite: ZO 201
The course is designed to give students a knowledge and appreciation of the life history, pathology and control of some common parasites. Messrs. Harkema, Miller
- ZO 345 HISTOLOGY 4 (2-4) F
Prerequisite: ZO 223 or ZO 351
The microscopic anatomy of animal tissues. Mr. Harkema
- ZO 350 INVERTEBRATE ZOOLOGY 4 (2-6) S
Prerequisite: ZO 201
The biology and classification of the invertebrate animals with special reference to types commonly encountered and to those that illustrate zoological principles. Mrs. Bradbury
- ZO 351 VERTEBRATE ZOOLOGY 4 (3-3) S
Prerequisite: ZO 201
The biology of the vertebrates: their adaptations and evolutionary history. Comparative physiological, developmental, behavioral and anatomical studies. Mr. Martof
- ZO 353 WILDLIFE MANAGEMENT 3 (3-0) F S
Prerequisite: BS 100
The course describes the historical development from empirical practices to the scientific American system. Then, the principles of management, protection, and conservation of those warm blooded vertebrates of aesthetic, sport or food values in urban, rural and wilderness areas are considered. Staff
- ZO 360 (BO 360) INTRODUCTION TO ECOLOGY 4 (3-3) F S
(See botany, page 254.)
- ZO 361 VERTEBRATE EMBRYOLOGY 4 (3-3) S
Prerequisite: ZO 223 or ZO 351
The study of fundamental principles that apply to the embryonic development of vertebrates. Mrs. Mueller
- ZO 401 (ENT 401) BIBLIOGRAPHIC RESEARCH IN BIOLOGY 1 (1-0) F
(See entomology, page 314.)
- ZO 414 (BO 414) CELL BIOLOGY 4 (3-3) F
Prerequisites: CH 223, PY 212
A study of the chemical and physical bases of cellular structure and function with emphasis on methods and interpretations. Mr. Roberts

ZO 420 FISHERY SCIENCE

3 (2-3) F

Prerequisites: ZO 201, ZO 360

The science of fishery biology: life history and biology of important game and commercial fishes, fishing methods, age and growth analysis, survey of fishery resources, tagging studies, population estimations and pollution studies.

Messrs. Hassler, Hester

ZO 421 VERTEBRATE PHYSIOLOGY

4 (3-3) F

Prerequisites: Organic chemistry, physics, ZO 201

Physiology of vertebrates with emphasis on mammals. A comprehensive study of the mechanisms that operate to sustain life.

Mr. Smith

ZO 441 ICHTHYOLOGY

3 (2-3) S

Prerequisite: ZO 223 or ZO 351

The classification and ecology of selected groups of fishes. Lectures, laboratories and field trips dealing with systematics, life histories, interrelationships and distribution.

Mr. Hassler

ZO 490 SPECIAL TOPICS IN ZOOLOGY

3 (2-1) F S

Prerequisites: Junior standing

Organized, formal lectures and discussions of a special topic or an investigation of topics of particular interest to students under the direction of a faculty member on a tutorial basis.

Staff

SPECIALIZED COURSES**ZO 212 BASIC ANATOMY**

3 (2-2) F

Prerequisite: BS 100

A study of anatomy with major emphasis on the structure and function of the muscular, skeletal, circulatory and nervous systems. Required of majors in recreation and students in the nurses' program.

Mrs. Mueller

ZO 213 BASIC PHYSIOLOGY

3 (3-0) S

Prerequisite: ZO 212 or consent of instructor

A survey of physiology. The central theme is the changes in the body accompanying physical activity. The nature and mechanisms of these changes.

Staff

ZO 214 BASIC PHYSIOLOGY

1 (0-3) S

Corequisite: ZO 213

Laboratory in physiology. Required of students in the nurses' program.

Staff

FOR GRADUATES AND ADVANCED UNDERGRADUATES**ZO 501 ORNITHOLOGY**

3 (2-3) F

Prerequisites: ZO 223 or ZO 351, ZO 421

The biology of birds: systematics, physiology, life histories, ecology and behavior.

Mr. Quay

ZO 503 (PSY 503) COMPARATIVE PSYCHOLOGY

3 (3-0) S

(See psychology, page 421.)

- ZO 510 ADAPTIVE BEHAVIOR OF ANIMALS 4 (3-3) F
Prerequisite: ZO 421 or consent of instructor
The comparative study of animal behavior including a treatment of physiological mechanisms and adaptive significance. Both invertebrates and vertebrates are studied. Staff
- ZO 513 (PHY 513) COMPARATIVE PHYSIOLOGY 4 (3-3) F
Prerequisites: ZO 421 and ZO 350 or consent of instructor
A comparative study of the organ systems of vertebrates and invertebrates and the physiological processes involved in maintaining the homeostatic state. The various compensatory mechanisms employed during environmental stress are included. Mr. Lee
- ZO 515 GROWTH AND REPRODUCTION OF FISHES 3 (2-3) S
Prerequisites or corequisites: GN 411, ZO 420, ZO 421, ZO 441
The biology of fishes: physiology, anatomy, pathology, behavior and genetics. This course is designed especially for graduate students in fisheries. Several trips to research laboratories are taken. (Offered in spring 1971 and alternate years.) Mr. Hester
- ZO 517 POPULATION ECOLOGY 3 (3-0) S
Prerequisites: ZO 360 and ST 511 or equivalent
The dynamics of natural populations. Current work, theories and problems dealing with population growth, fluctuation, limitation and patterns of dispersion, the ecological niche, food chains and energy flow. Emphasis on methods of study. Messrs. Hayne, Davis
- ZO 519 LIMNOLOGY 4 (3-3) F
Prerequisite: ZO 360 or equivalent
A study of inland waters. Lectures dealing with physical, chemical and biological factors that affect freshwater organisms. General principles are illustrated in the laboratory and on field trips. Mr. Hobbie
- ZO 524 (PO 524) COMPARATIVE ENDOCRINOLOGY 4 (3-3) S
(See poultry science, page 417.)
- ZO 529 (MAS 529) BIOLOGICAL OCEANOGRAPHY 3 (3-0) S
Prerequisite: ZO 360 or consent of instructor
A comprehensive course stressing the dynamic interrelationships between organisms of the sea and their physical and chemical environment. The latter part of the course will examine fundamental concepts in biological oceanography and will particularly stress experimental methods. Mr. Copeland
- ZO 532 (GN 532) BIOLOGICAL EFFECTS OF RADIATIONS 3 (3-0) S
(See genetics, page 325.)
- ZO 540 (GN 540) EVOLUTION 3 (3-0) F
(See genetics, page 325.)
- ZO 542 HERPETOLOGY 3 (2-3) S
Prerequisites: ZO 223 or ZO 351, ZO 421
The biology of the amphibians and reptiles: systematics, life history, anatomy, behavior, physiology and ecology. Mr. Martof

- ZO 544 MAMMALOGY** 3 (2-3) S
 Prerequisites: ZO 223 or ZO 351, consent of instructor
 The classification, identification and ecology of the major groups of mammals.
 Messrs. Barkalow, Davis
- ZO 550 (GN 550) EXPERIMENTAL EVOLUTION** 3 (3-0) F
 (See genetics, page 325.)
- ZO 553 PRINCIPLES OF WILDLIFE SCIENCE** 3 (2-3) F
 Prerequisites: ZO 360
 The principles of wildlife management and their application are studied in the laboratory and in the field.
 Mr. Barkalow
- ZO 555 (MB 555) PROTOZOOLOGY** 4 (2-6) F
 Prerequisite: ZO 350 or equivalent
 The biology of the Protozoa: lectures included morphology, physiology, ecology, genetics, reproduction, evolution, systematics and life-cycles of both free-living and parasitic taxa; laboratory will stress recognition of selected forms and demonstrate techniques used to prepare specimens for microscopic examination. Mrs. Bradbury
- ZO 560 (BO 560) PRINCIPLES OF ECOLOGY** 4 (3-3) F
 Prerequisite: Three semesters of college-level biology courses
 A consideration of the principles of ecology at the graduate level. Each of the major subject areas of ecology is developed in sufficient depth to provide a factual and philosophical framework for the understanding of ecology.
 Messrs. Standaert, Blum
- ZO 575 (PHY 575, ENT 575) PHYSIOLOGY OF INVERTEBRATES** 3 (3-0) S
 Prerequisite: ZO 350 or consent of instructor
 The course will deal with physiology of invertebrates including the insects but excluding the Protozoa. The unity of the physiology of the various groups will be stressed.
 Staff
- ZO 581 HELMINTHOLOGY** 4 (2-4) F
 Prerequisites: ZO 223 or ZO 351, ZO 315 or equivalent
 The study of the morphology, biology and control of the parasitic helminths.
 Mr. Miller
- ZO 582 (ENT 582) MEDICAL AND VETERINARY ENTOMOLOGY** 3 (2-3) S
 (See entomology, page 316.)
- ZO 590 SPECIAL STUDIES** Credits Arranged
 Prerequisites: Twelve hours zoology, consent of instructor
 Maximum three hours for degree
 A directed individual investigation of a particular problem in zoology, accompanied by a review of the pertinent literature.
 Staff
- ZO 592 TOPICAL PROBLEMS** 1-3
 Prerequisite: Consent of instructor
 Organized, formal lectures and discussions of a special topic.
 Staff

FOR GRADUATES ONLY

ZO 603	ADVANCED PARASITOLOGY	3 (2-3) S
ZO 610	CURRENT ASPECTS OF ANIMAL BEHAVIOR	4 (3-3) F
ZO 614	ADVANCED CELL BIOLOGY	3 (3-0) S
ZO 615	ADVANCED CELL BIOLOGY LAB	1 (0-3) S
ZO 619	ADVANCED LIMNOLOGY	3 (1-6) S
ZO 621	FISHERY SCIENCE	3 (2-3) F
ZO 660 (BO 660)	ADVANCED TOPICS IN ECOLOGY I	4 (3-3) S
ZO 661 (BO 661)	ADVANCED TOPICS IN ECOLOGY II	4 (3-3) S
ZO 690	SEMINAR	1 (1-0) F S
ZO 699	RESEARCH IN ZOOLOGY	Credits Arranged

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- VICTOR G. SORRELL**
Head Baseball Coach Emeritus.
- ALFRED J. STAMM**
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- ARTHUR JOSEPH WOODBURY
Assistant Professor Emeritus of Textile Research. Lowell Textile Institute

The Alumni Association

BRYCE R. YOUNTS, *Director of Alumni Affairs*

The Office of Alumni Affairs maintains direct contact between North Carolina State University and her alumni. The Alumni Association has been organized for the purpose of promoting the growth, progress and general welfare of the University: to foster among its students and former students a sentiment of regard for one another and a continuing attachment to their Alma Mater; and to interest prospective students in enrolling at North Carolina State University.

ASSOCIATION MEMBERSHIP

Active membership is available to all former students, regardless of length of stay at the University; members of the faculty, administrative staff, Agricultural Extension Service, Agricultural Experiment Station, teachers of agriculture in North Carolina high schools and all persons who have successfully completed a short course at North Carolina State University. Honorary membership in the Association may be conferred on those distinguished persons as are duly elected.

The Association meets annually during Alumni Week End. Class reunions, scheduled for each class at five-year intervals following graduation, are also held each year in connection with Alumni Week End. Officers of the Association are elected annually by the active membership by mail ballot. Local alumni clubs are organized in most of the counties in North Carolina and in a number of cities in other states.

THE ALUMNI LOYALTY FUND

The Alumni Loyalty Fund was established by the Association in 1952 to replace the dues-paying program then in effect. This fund provides a means through which alumni may contribute to the progress of North Carolina State University. Every alumnus is invited to make a voluntary annual contribution.

NCSU ALUMNI NEWS

This is the official publication of the Alumni Association and is published bimonthly. Its purpose is to enable members to keep in touch with each other and with the University. All alumni fund contributors receive the *Alumni News* on a regular basis. Included in the magazine are news and pictures of the University, its students, faculty and alumni as well as articles of a general nature dealing with timely subjects in the field of higher education.

THE ALUMNI OFFICE

The Office of Alumni Affairs is located in the Alumni Memorial Building on the eastern edge of the campus. It serves as headquarters

for visiting alumni, and houses records of all alumni, both graduates and nongraduates. The files include individual biographical information, mailing lists by classes and geographical areas and certain other specific data.

Constant effort is made to facilitate an exchange of ideas and suggestions between the alumni, students and the University. The Office of Alumni Affairs serves as the focal point through which this objective is accomplished. Activities involving alumni, students, and faculty members are included in the program of the Association in an effort to foster a closer relationship between all groups so important in the life of the University.

Foundations And Development

RUDOLPH PATE, *Director*

The Office of Foundations and Development is the principal private fund raising and public affairs division of the University. It embraces the work of nine incorporated foundations, alumni affairs, news services, University publications and general public relations activities. It is concerned with all programs of public affairs and interpretation of the University in the public context.

The foundations include the North Carolina State University Foundation, Inc., the North Carolina Agricultural Foundation, Inc., the North Carolina Dairy Foundation, Inc., the North Carolina Engineering Foundation, Inc., the North Carolina Textile Foundation, Inc., the North Carolina Design Foundation, Inc., the North Carolina Forestry Foundation, the Pulp and Paper Foundation, Inc., and the North Carolina 4-H Development Fund, Inc.

NORTH CAROLINA STATE UNIVERSITY FOUNDATION

The North Carolina State University Foundation, Inc., was organized December 11, 1942, to foster and promote the general welfare of North Carolina State University and to receive and administer gifts and donations for such purposes.

AGRICULTURAL FOUNDATION

The North Carolina Agricultural Foundation, Inc., renders financial assistance in the development of strong teaching, research and extension programs in agriculture through the School of Agriculture and Life Sciences at North Carolina State University.

DAIRY FOUNDATION

The North Carolina Dairy Foundation, Inc., aims to promote and improve all phases of dairying in North Carolina through education, research and extension. A 48-member board of directors handles the affairs

of the foundation. These directors represent distributors, producers and jobbers.

ENGINEERING FOUNDATION

The North Carolina Engineering Foundation, Inc., gives financial assistance to the programs in the Schools of Engineering and Physical and Mathematical Sciences.

TEXTILE FOUNDATION

The North Carolina Textile Foundation, Inc., was formed to promote the development of the School of Textiles, and was incorporated December 31, 1942. Funds for this foundation have been raised largely from textile manufacturing plants, other corporations and industries closely allied with textiles.

DESIGN FOUNDATION

The North Carolina Design Foundation, Inc., was organized in January, 1949. Foundation funds are used for the promotion and advancement of the School of Design at North Carolina State University.

FORESTRY FOUNDATION

The North Carolina Forestry Foundation was incorporated April 15, 1929. The Foundation has acquired a tract of land known as the Hofmann Forest, consisting of about 80,000 acres in Jones and Onslow counties, which is used as a demonstration and research laboratory for the School of Forest Resources at North Carolina State University.

PULP AND PAPER FOUNDATION

The Pulp and Paper Foundation, Inc., was incorporated December 19, 1954, by the Southern pulp and paper mills for the purpose of supporting the program of pulp and paper technology in the School of Forest Resources.

4-H DEVELOPMENT FUND

The North Carolina 4-H Development Fund, Inc., was organized in 1959. Four-H Development Fund monies are used to promote and advance all areas of 4-H Club work in North Carolina.

UNIVERSITY DISRUPTIONS POLICY AND PROCEDURES

The following statement is from the University By-Laws as established by the Board of Trustees:

SEC. 5-1. Definition of Disruptive Conduct

The University of North Carolina has long honored the right of free discussion and expression, peaceful picketing and demonstrations, the right to petition and peaceably to assemble. That these rights are a part of the fabric of this institution is not questioned. They must remain secure. It is equally clear, however, that in a community of learning, willful disruption of the educational process, destruction of property, and interference with the rights of other members of the community cannot be tolerated.

(a) Any student, faculty member (including full-time or part-time instructor), or employee who willfully by use of violence, force, coercion, threat, intimidation or fear, obstructs, disrupts or attempts to obstruct or disrupt, the normal operations or functions of any of the component institutions of the University, or who advises, procures, or incites others to do so, shall be subject to suspension, expulsion, discharge, or dismissal from the University. The following, while not intended to be exclusive, illustrate the offenses encompassed herein: occupation of any University building or part thereof with intent to deprive others of its use; blocking the entrance or exit of any University building or corridor or room therein; setting fire to or by any other means substantially damaging any University building or property, or the property of others on University premises; except as necessary for law enforcement, any display of or attempt or threat to use firearms or explosives or, for the purpose of intimidating, other weapons, in any University building or on any University campus; prevention of the convening, continuation or orderly conduct of any University class or activity or of any lawful meeting or assembly in any University building or on any University campus; inciting or organizing attempts to prevent student attendance at classes; and, except with the permission of the Chancellor, blocking normal pedestrian or vehicular traffic on any University campus.

(b) Any faculty member (including any full-time or part-time instructor) who, with intent to obstruct or disrupt the normal operations or functions of any of the component institutions of the University, willfully fails or refuses to carry out validly assigned duties shall be subject to discharge.

SEC. 5-2. Responsibility of Chancellor

(a) The Chancellor or his representatives shall have a duty to identify persons who violate the provisions of Sections 5-1 (a) or (b) and promptly report their names to the President. In any such instance the Chancellor or his representative shall marshal the evidence, and the Chancellor shall report it to the President in writing.

(b) The Chancellor or his representative may recommend to the President that injunctive relief be sought from the courts to prevent

occurrence, continuation, or recurrence of a violation of Section 5-1 (a).

SEC. 5-3. Responsibility of the President

When it appears that there is a violation of Sections 5-1 (a) or (b), it shall be the duty of the President, and he is fully authorized to act, to take all steps which he deems advisable to protect the best interest of the University of North Carolina and any of its component institutions, and to see that its Rules, Regulations and Policies are enforced. He shall insure that any person or persons found guilty after proper hearing shall be disciplined in such manner as may be warranted.

In carrying out these duties, the President may call upon any Chancellor, member of the University Administration, or member of the Faculty, and he may call upon any agency of a component institution created to deal with cases arising under Section 5-1 of these By-Laws. Conviction in any State or Federal Court shall not preclude the University from exercising its disciplinary authority in any offense under this or any other section of the By-Laws.

SEC. 5-4. Responsibility of the Trustees

The Trustees recognize that by statute they have the power to make such rules and regulations for the management of the University as they may deem necessary and expedient, not inconsistent with the constitution and laws of the State. While the Trustees fully appreciate their obligation in this respect, they further recognize that in dealing with those offenses against the University defined in Section 5-1 (a) and (b) hereof, they must impose the duty and authority of enforcing the policies set forth herein in the principal Executive Officer of the University—the President. It will be the responsibility of the Trustees to furnish all possible assistance to the President when requested by him.

SEC. 5-5. No Amnesty

No administrative official, faculty member, student, or employee of the University shall have authority to grant amnesty or to make any promise as to prosecution or nonprosecution in any court, state or federal, or before any student, faculty, administrative, or Trustee committee to any person charged with or suspected of violating Section 5-1 (a) or (b) of these By-Laws.

SEC. 5-6. Firearms and Other Weapons Prohibited

The possession of bowie knives, dirks, daggers, loaded canes, sword canes, machetes, pistols, rifles, repeating rifles, shotguns, pump guns, or other firearms or explosives upon any University campus or in any University owned or operated facility, unless explicitly permitted by the appropriate Chancellor or his designated representative in writing, is forbidden. Violation of this prohibition constitutes grounds for suspension from the University.

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